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The Salvage of Deeply Sunken Ships

By R. G. Skerrett

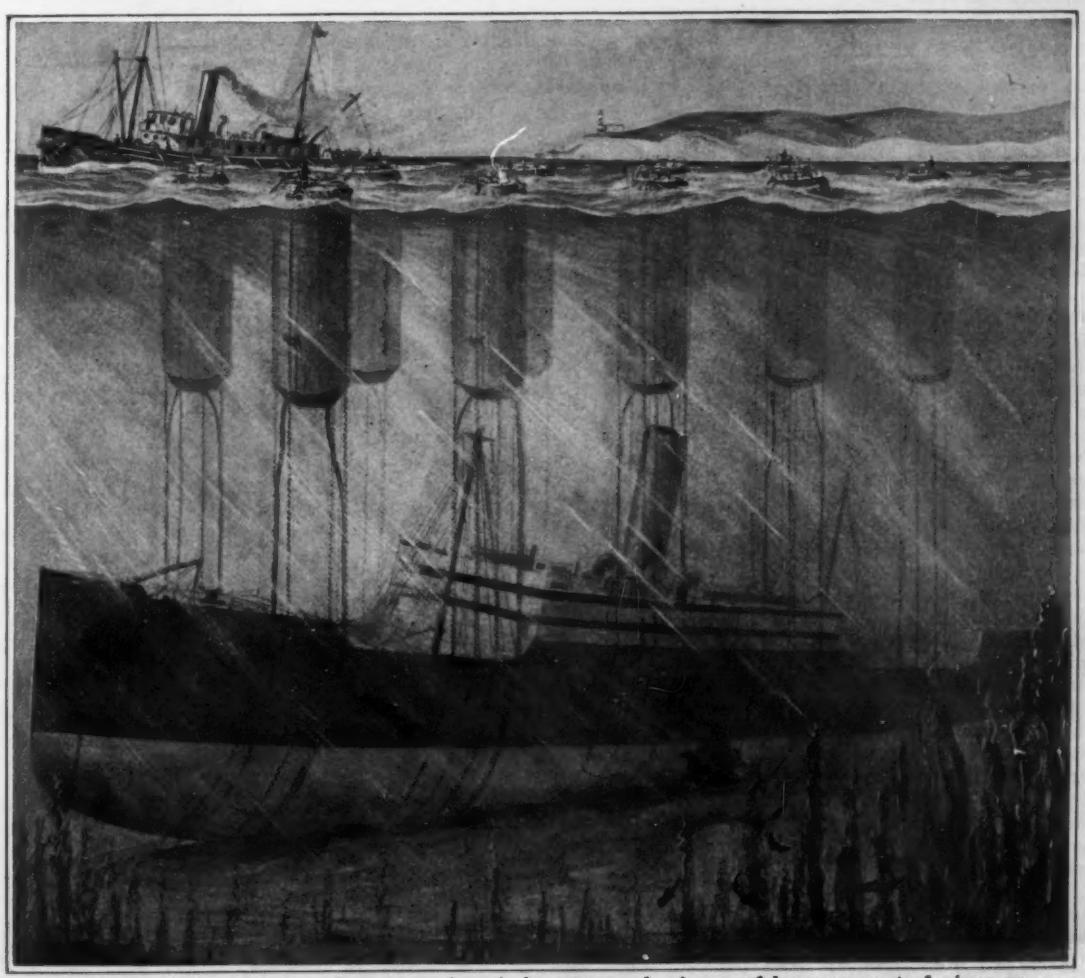
WHEN the war is over and details are allowed the public, nothing will be more worth while than the story of just how the ravages of storms and U-boats have been minimized by marine salvors in the recovery of hundreds of stricken vessels. Wrecking experts have been achieving veritable wonders through the employment of improved salvage agencies, but there is room still for betterment in these facilities in order to speed up refloating, to offset the handicap of deep submergence, and to battle more successfully with fickle weather and the sea's changeful moods.

The average layman but little knows the difficulties that have to be overcome in dealing with a sunken ship, particularly if the craft lie wellnigh wholly below the surface of the water. But engineers are generally alive to the enormous task of handling an immersed body weighing some thousands of tons, especially where the only foothold available for exerting a lift is the somewhat uncertain one offered by the water's surface. The foundered vessel rests inert upon the sea floor, and to her deadweight may possibly be added the suction-like grip of the sand or mud of the bottom. The salvor's problem is a manifold one. He must break the restraining hold of the seabed; he must exert, through buoyancy, an upward pull of sufficient moment to dislodge the sunken craft; he must support the ship upon great wire-rope hawsers placed beneath her at several points so as to bear her up without tending to break her back; he must gradually work her from a position of peril into some haven where she can be dealt with deliberately and made whole again; he must be prepared to neutralize as far as practicable the stresses of stormy weather; he must make temporary repairs under the most trying of conditions; these and other things he must do to insure success without being able at any time, so to speak, to set his feet firmly on a sure foundation in order to exert the forces at his disposal.

The British Admiralty has recently given out some information regarding the feats performed by its Salvage Department and has announced with pardonable pride that more than 400 ships have been dealt with successfully! Under the conditions existing, the performance is, indeed, a highly commendable one. Among some of the things done were the raising of a big collier sunk in 72 feet of water, which involved the lifting of a dead load of 3,500 tons! Another achievement was that of refloating a vessel that had gone to the bottom in 90 feet of water—her salvage being effected by the use of compressed air. The British authorities do not explain how the compressed air was employed.

It is not unlikely, however, that the last undertaking was made practicable by utilizing "camels" or submergible pontoons. Steel cylinders of this sort were used ten years ago with conspicuous success in refloating, in shallow water, a naval craft of 6,000 tons dead weight not far from Yarmouth, England. The camels were sunk close to the ship and parallel with her length and then made buoyant by compressed air forced into them to expel the water ballast. The pontoons were 12 feet in diameter and varied in length from 40 to 75 feet. They exerted their buoyant pull through wire cables strapped to the cruiser; and, depending upon the length of the camels, they distributed their effort through from two to four of these lines.

While ultimately successful, the work at different stages was very much hampered by the difficulties encountered in controlling the pontoons, especially after reaching the surface, and in maintaining a proper distribution of the load in each case. The strain on the various lines had to be equalized, and the longer camels were hardest to deal with in this respect because the least seaway altered the stresses by shifting the center of buoyancy in the undulating water. The variable support resulting from this movement broke the straps time and again and threatened upon a number of occasions to deform the cylinders and to cause their collapse. These details are of present interest owing to the fact that a recent invention promises to modify radically the procedure in using cylindrical pontoons for the refloating of vessels entirely submerged.



Salving a ship in deep water by means of vertical pontoons, showing careful arrangement of wire-rope hawsers to prevent injury to the submerged hull

Carl J. Lindquist has devised a semi-submergible cylindrical pontoon which does its work with its long axis vertical instead of horizontal, as is the usual custom, and by this means he reduces greatly the changing forces incident to a seaway. That is to say, while each of his pontoons is 60 feet long and 21 feet in diameter, his floating body is virtually equivalent to a navigational buoy, and, therefore, decidedly different from a cylinder of the same length bobbing about while lying prone upon the water. Further, the new pontoon bears its load vertically through its longitudinal axis and distributes the burden in a way to utilize the maximum strength of its structure.

By means of an ingenious arrangement of four chain cables, secured to a sliding windlass on the top of the pontoon, the stress on all of them is automatically equalized and the buoyant cylinder is left, within limits, free to accommodate itself to the varying motion of a seaway. Each pontoon is divided into three separate watertight compartments; and the intention is that one, if not two of these, shall be charged with compressed air before leaving a harbor for salvage service. The bottom compartment is designed to receive water ballast so as to bring the pontoon into a vertical position after it has been towed horizontally to the site of the wreck. As is the customary practice, the pontoons would be used in pairs, linked together by a sling which would be passed under the keel of the vessel to be raised; and the sling would be set agreeably to the depth of the wreck and secured to the pontoons before leaving port. That is to say, nearly all of the hazardous work of this character would be done in a harbor in advance of starting the actual salvage operations.

Strapped along the entire length of the sling would be a flexible hose with perforations at the lowermost section, and this pipe would form a conduit for the compressed air stored in the pontoon. The purpose of this arrangement is to excavate the mud or sand by an air discharge under the keel of the sunken vessel, and thus to facilitate the sliding of the various slings into their proper positions beneath the craft. Experiments and practical work have proved that an air blast of this sort will clear away mud or sand in contact with the bottom of a submerged ship and, incidentally, break the seal which would otherwise hold her fast in spite of all the buoyancy that might be brought into play.

In employing submergible pontoons in the past, serious trouble has been experienced owing to the slipping of the slings and the shiftings of the supported vessel. Mr. Lindquist minimizes this danger by drawing each pair of pontoons close together and passing around them a band of chain which is permitted to drop upon the vessel and to form a bridle to hold the sling in place. According to his figures, a pair of pontoons would have an effective lifting capacity of 612 tons; and because their diameters and not their lengths limit the number that can be employed on any job, it is plain that an exceptionally large measure of buoyancy can be brought into

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Fifteen Months of War Preparation

BOTH the country in general and the War Department in particular are to be congratulated upon the change of policy on the part of the Department in substituting for the abysmal secrecy and mystifying censorship of the earlier months of the war, a policy of frank revelation of our progress in developing the military establishment.

The motive for this commendable charge is not revealed; but we shall not be far wrong if we accept it as a recognition by the Administration of the noble spirit in which the country has risen to the call of its President, as shown in its unquestioning acceptance of the Draft, in its generous response to the call of the Liberty Loans, and in the unostentatious patriotism with which it has practised the thousand-and-one self-denials and economies imposed by the exigencies of the war.

The reply of Secretary Baker to the request of the Committee on Military affairs of the House for a summary of our accomplishment since the declaration of war is most encouraging. The delay at the start was more apparent then real. Had we aimed at making a quick showing on a smaller scale, the thing could have been done; but we think the Secretary scores a strong point when he says that, because the War Department understood the magnitude of the task, it realized that the time consumed in the preparations for a vast army of many millions, would prove, in the long run, to be time saved. That the policy adopted was right is shown by the fact that today we have in Europe an army of over one million men, and that we are now sending our troops across the water at the rate of nearly 300,000 men per month.

The one discouraging element in Mr. Baker's report is the statement on heavy artillery, regarding which most essential arm he can say no more than that "the artillery program is now approaching a point where quantity production is beginning." When the Secretary says, "The most difficult undertaking in the outfitting of an army is the manufacture of heavy artillery," he is telling the country what, thanks to the reiterated warnings of General Wood from the outbreak of the war, now some four years ago, the country and its Congress has well understood.

The magnitude of the task is shown by the fact that sixteen plants had to be provided for the manufacture of mobile artillery cannon, and in practically all cases these plants had to be retooled, and in some cases they were built from the ground up. The same difficulty has developed in the manufacture of artillery carriages.

The enormous demand for explosives is being met on a proportionate scale. Our private facilities for making powder and explosives were the largest in the world; but the Government has provided additional facilities which "are very much larger than those which private enterprise had created."

It is exceedingly gratifying to learn that our ordnance engineers "are well on the way to a solution of the problem of rendering field artillery more mobile by motorization." We now have a 5-ton armored artillery tractor, which proved capable of negotiating the most difficult terrain, hauling a 4.7-inch howitzer. This means that when we break through the German lines, our artillery will be able to keep pace with our shock troops and prevent the stabilization of the retreating German forces.

The present strength of our army is as follows: We have in the Regular Army, 11,365 officers and 514,376 men; in the National Guard in Federal service, 17,070 officers and 417,441 enlisted men; in the Reserve Corps, 131,968 officers and 78,560 men; and in the National Army an enlisted force of approximately 1,000,000 men. The grand total for the whole army is 160,400 officers and 2,010,000 men.

When we bear in mind that when war was declared we had only 9,524 officers and 202,510 men, the result can fairly be set down as a truly magnificent achievement, and particularly so when we remember that one half of this large force, or over 1,000,000 men, has been carried some 3,000 miles to Europe, through waters infested with the German submarine.

In the matter of rifles and machine guns, from the declaration of war to June 1st, 1918, 1,300,000 rifles were produced in America and delivered. The deliveries of the new modified Enfield have exceeded one million, and today they are being received at a rate sufficient to equip an army division every three days.

Conditions have improved in the matter of machine guns. Heavy Browning guns are being used in every National Guard Camp and in every National Army cantonment in the United States. Nine hundred of the heavy and eighteen hundred of the light Browning machine guns were delivered in May.

The delays in the delivery of airplanes is well known. It was due in part to the vast scale of our preparations. Today we are fully embarked on quantity production. By June 8th there had been delivered 4,495 elementary and 820 advanced training planes. Due to the vast scale on which our motor and plane factories have been organized and built, the output is now on a rapidly rising scale. The average weekly production of advanced training planes during April was 22; during May, 45½; during the first week of June, 78. The average weekly output of combat planes was for April, 5; for May, 38; for week ending June 8th, 80. To June 8th 6,880 elementary training engines were delivered and 2,133 advanced training engines. More than two thousand Liberty engines have been delivered to the Army and Navy, and 37,250 machine guns have been delivered for use on airplanes.

When the organization of five new regiments and nineteen battalions of railway engineers has been completed there will be over 45,000 American Engineers in railroad construction and operation in France. For the same service 22,000 standard and narrow gage cars and 1,600 locomotives have been produced. A double track line several hundred miles, extending from the coast to the battlefront, has been taken over from the French, and reconstruction work, including hundreds of miles of yard trackage, has been done.

Finally there is consensus of opinion from official and journalistic observers in France, including the Secretary himself, that the moral tone of our army is high and that drunkenness is practically non-existent. Furthermore, the Secretary says, "The desire among men in the military service to get to France and to the front is universal"; so much so that it was necessary to change the name of the zone behind the armies from the Service of the Rear to Service of Supply.

Dust and Fire

WHEN we want to start a fire in a stove, we do not try to set fire to a large stick of wood with a match. We do not even stop with splitting the large stick into smaller ones. To get a good cracking fire immediately, we reduce one of our big sticks to shavings; and at the touch of a match off it goes.

If these shavings were ground to a coarse powder, spread out in a thin layer, and ignited, this powder would burn very rapidly. If it were ground fine and scattered about so that it became mixed with the air of the room, we would not even need a match to ignite it. A very small electric or friction spark might cause this dust-laden air to take fire and burn so rapidly that it would produce an explosion. For the only difference between the halting combustion of a pile of damp leaves and the explosion which sends a giant projectile on its way is that the leaves burn slowly, giving the gaseous products of combustion time to dissipate themselves without crowding or violent expansion, while the powder burns with such extreme rapidity that gas is created faster than it can possibly find vent. And pursuing the thing one step further toward its fundamentals, the rapidity of burning, other things being equal, is wholly a question of exposed surface. Substances which at the temperature of ordinary flame ignite with difficulty or not at all will burn keenly and even explode if we divide them into sufficiently small particles to afford a sufficiently large exposed surface.

We have used wood as a familiar illustration of this fact, but it is true not of this alone; almost any kind of finely divided matter containing carbon burns, under favorable conditions, with a speed that converts combustion into explosion. Among such dusts are those of grain, flour, sugar, rice, feed, paper, cotton, leather, wood, cork and fertilizer.

Now it happens that in the manufacture and commercial handling of the products just catalogued, it is not possible to avoid the creation of a considerable quantity of dust. We cannot grind or cut or scrape or polish or beat or perform any other mechanical work calculated to change the form of our medium, without having a certain proportion of that medium pass off as dust. Finely divided matter like flour, loose bulk substances like grain, large pieces of materials as soft as wood and leather, cannot even be moved from place to place without more or less loss by attrition. And we cannot have manufacture or transportation or commercial usage of any sort without employing either mechancial processes which create friction, or electricity. In other words, we can never handle these dust-producing materials except under conditions giving more or less probability of sparks. This probability is greater if we are careless, less in direct ratio with the degree of care we exercise. With the utmost care, however, we can only make the chance of sparks approach zero; it will never vanish altogether.

This does not in the least mean that it is futile to exercise care; on the contrary, it means that we can never be too careful, that every additional precaution decreases the risk. At the present time above all others we must be prepared to carry caution to the limit. The materials causing dust are all of such nature that the fire following an explosion of that dust destroys them beyond hope of salvage. Likewise they are the things—food for man and beast, leather, textiles—of which we are in greatest need right now, and of which extra production is hardly to be had. If we want more coal or iron, the coal or iron is there; we have only to dig so much more out of the ground, and deal with the problems of transportation. But the amount of food or of cotton or of leather that we can have in a given year is determined in advance by the size of the year's planting or the year's herds. Every dollar's worth destroyed by fire means, not that we must work a bit harder and produce an extra dollar's worth to meet the deficit, but that we must actually accommodate ourselves to the deficit and get along without that dollar's worth.

Accordingly it is strictly up to us to prevent explosions and fires caused by dust, so far as it is humanly possible to do so. Dust, with its allies, Spark and Flame, is eternally plotting to destroy valuable property, valuable foodstuffs, even valuable lives. Only by eternal vigilance can it be defeated. The man who handles foodstuffs and textiles will, by virtue of his own common sense, recognize a good many ways of meeting the situation. If he will but ask it, the Department of Agriculture will tell him in addition all that it knows, will share with him the body of knowledge got by years of careful watching of the right and the wrong ways of storing and handling. With the season of manufacture and storage of food against the coming winter now at hand, it is in order for every one engaged in that work to find out what contribution he can make to the common cause.

The experience which others have bought with million-dollar fires is to be had for the price of a three-cent stamp. So write the Department of Agriculture for its booklet on the prevention of grain-dust fires; and after you have read it, try to think of some questions to ask the Department's experts that will help you in your business.

In one explosion last year enough grain was destroyed to supply 200,000 soldiers with bread rations for a year. Don't let this happen to you!

The Individual Responsibility

WE are told that ships will win the war, that food will win the war, that coal will win the war. So they will, if they get the chance. But ships, food, coal, are all inanimate and impersonal; and the only way in which they can be put to work for the winning of the war or the achievement of any other purpose is by the hands of men. It is only through the agency of human labor that ships or food or coal can be produced or used; so when we come right down to rock bottom, it is individual effort that is going to win the war, and nothing else.

Non-existent is the man whose individual efforts have no bearing upon either the production or the use of some necessity of war. For at the very least, we all eat, and in eating consume food; and food is one of the very biggest potential agents of victory. So it behooves every individual to put forth every possible effort to place production safely ahead of consumption.

Some can do more than others, for some hold positions of more responsibility than others. We are all too wont to ask what is the use of saving a shovelful of coal when another can save a ton; or what is the use of unloading a single car a day earlier when we see whole trains remaining unmoved for days at a time; or what is the use of keeping a handful of food out of the garbage pail when whole shipments of fruit go bad through somebody's negligence; or what is the use of cultivating this tiny patch here, when that large one over yonder is held unproductive by shiftlessness or absentee ownership. In every case the answer to such a question is that a big wrong and a little one do not make a right, but rather combine to make a bigger wrong. The use of saving a shovelful of coal is that shovelful; the business of the man with the shovel is to save his shovelful, not to worry about what the other fellow is doing with his tons.

Our best national effort is the sum total of our individual efforts. The man who measures his effort by that of someone else is not giving his own best effort, and until he sees the error of his ways and mends them our national effort is not a maximum. Every little bit added to production or withheld from consumption is an object in itself. The individual effort that will win the war is the individual effort of every American.

Naval and Military

Machine Guns and Small Arms.—On the first of June it was stated in the House that in 18 days of May 659 heavy Browning machine guns were delivered to the United States Government by two firms. In the beginning of June heavy Browning machine guns were being produced at the rate of over 1,000 a month; in May the delivery of light Brownings was 1,800; and during the early summer the normal output will be carried to 10,000 a month, should it be necessary. That excellent trench warfare weapon, the Colt automatic pistol, is being delivered at the rate of 40,000 per month. At the beginning of June the new Enfield rifle was being put out at the rate of 9,000 per day.

"Tuckahoe" Maintains Her Record.—A new fast pace for coastwise commerce has been set by the speed ship "Tuckahoe." The famous collier, which was built in the record breaking time of 37 days, in the first month of her active service ending on Friday, June 21, has taken four cargoes of coal from Norfolk and Baltimore to Boston. These four cargoes have totalled approximately 19,000 tons. Two round trips a month have been the average performances of steamers engaged in the New England coal carrying trade. The fastest round trip of the "Tuckahoe" has been seven days, as against the average time of 14½ days. The slowest round trip of the "Tuckahoe" has been 12 days, and this was due to a change of her crew in Boston, delaying her four days in port.

Rifles for 2,000,000 Men.—The War Department states that early in June the production of rifles for the Army will exceed 1,500,000, divided as follows: of the new modified Enfields, 1,140,595; of the Springfields, 176,796; rifles made for Russia but not delivered to her, 251,270. Also there is the equivalent of 100,000 Enfields and 100,000 Springfields made up in spare parts. The Russian rifles are being used for training purposes and for the equipment of the Home Guards, and all the rest of the guns go into the hands of the soldiers destined for service in Europe. In addition to the rifles made since war began, 600,000 Springfields, a most excellent weapon, are in use. About one-half the soldiers in an army carry rifles, hence the War Department has rifles for an army of 2,000,000 men, allowing wastage for one year.

New Shell-Loading Plants.—The new Chief of Ordnance, General C. C. Williams, states that the first of the new Government plants for filling shells with explosives is now in operation. The second plant is about to enter upon operation; a third plant will commence in July and a fourth in August. Each plant costs $5,000,000. The plans call for a total daily loading of 100,000 3-inch shells, 48,000 6-inch shells and 16,000 8-inch shells. Two of the plants will also load each day 15,000 4.7 shells. These shells will be additional to the enormous output of private plants. Of the 16,000 laborers employed, 4,000 will be women. Ultimately it is expected that 60 per cent of the total employed will be women. A laborer working by hand could formerly load seven shells an hour. The same man using a pneumatic vibrating machine can load, while working on five shells simultaneously, a total of 50 shells an hour.

Anti-Tank Gun.—A new anti-tank gun, which has already been used against the German tanks and has proved that it can put them out of action with a few well aimed shots, has been developed by the United States Ordnance factories and is now being produced in increasing numbers. The bore of the gun is just under 1½ inches and it fires a 1½ pound shell. The rapidity of fire is high, reaching 25 aimed shots per minute. Several varieties of shells are being manufactured, including an armor-piercing explosive shell. The gun, including its mounting, weighs only about 175 pounds; so that during an attack two men can carry the gun and another two the mount. The gun is so simple and can be assembled so rapidly that it could be brought from a dugout and get into action between the time when the enemy barrage lifts and the attacking forces reach one's own advance posts. The gun has a high velocity and a low trajectory.

Disastrous Competition for Labor.—The treasurer of a local industrial concern writes to Henry A. Wise Wood, who has forwarded the communication to us, that, at Milton, Pa., there is a plant making shells for our Government and also for the Allies; two large plants making other things necessary for the war; and just above Milton, a plant making brick needed in acid plants; while a few miles further on, there is a clay working plant, whose output is used in various Government buildings which are being erected for war work. Instead of cooperating in the interests of the war, all of these plants are bidding against each other for labor, and the wage scale goes steadily up without, however, attracting any more greatly needed labor to that vicinity. Due to this competition, men move from plant to plant with intervals of idleness between, the high wage scale rendering it possible for them to do this. The situation at Milton, Pa., can be duplicated a thousand times throughout the country.

Science

Trained Secretaries for Hospitals and Physicians.—Simmons College, in Boston, has undertaken the training of women to act as secretaries in hospitals and dispensaries or to private physicians. Their training includes, besides technical secretarial work, a knowledge of medical terms, scientific German, and general and special science as applied in the diagnostic laboratory.

Rasmussen's Explorations in Greenland.—According to press reports, Knud Rasmussen, the well-known Danish explorer, who set out on his second "Thule expedition" in April, 1916, has reached Long's Firth, with the survivors of his party, having completed the charting of all the firths or fjords of northern Greenland. Two members of the party, Hendrik Olsen and Dr. Wulff, perished in the course of the expedition, and the other explorers suffered great hardships.

A Low Temperature "Record" for North America.—In a recent review of the severe winter of 1917-18 Dr. C. F. Brooks states that a temperature of 86 degrees below zero Fahrenheit was reported in December from the Upper Yukon, at the mouth of the Pelly River, and that this observation, if authentic, establishes a "record" for North America. The lowest temperature ever recorded in the world (disregarding upper-air observations) was 90.4 degrees below zero Fahrenheit at Verkhoyansk, Siberia, in 1892.

The Southernmost Meteorological Station.—The southernmost permanently inhabited spot in the world is Laurie Island, in the South Orkneys, and its sole inhabitants are the party of meteorologists who maintain a station there for the meteorological service of Argentina. The Argentine government sent out a new staff last February, as usual, on a naval vessel, to relieve the observers, whose term of service in this desolate spot lasts one year. From time to time there has been talk of installing a wireless station at Laurie Island, but still the place is cut off from all communication with the rest of the world.

"Air Blasts" in the Kolar Gold Field.—At the last meeting of the American Association for the Advancement of Science, Mr. E. S. Moore presented a paper on the so-called "air blasts," a peculiar geological phenomenon of the well-known Kolar gold field of India. These blasts are explosions occurring in the walls of the workings on account of the potential energy in the quartz, schist and dike rocks of the region. The energy becomes active when mining operating relieve the pressure in certain directions. The source of energy is said to be found in the squeezing of the syncline of schist by the granite during compressional movements of the earth's crust.

The American Association of Clinical Psychologists is a new organization including in its membership persons holding the doctorate in psychology and engaged in the clinical practice of physchology in the United States. The 45 charter members comprise directors of clinics, bureaus of child welfare and institutional laboratories; persons engaged in military service as mental examiners of recruits and officers; experts connected with courts, hospitals and schools; etc. The association hopes to accomplish, among other things, the establishment of definite standards of professional fitness for the practice of psychology and to encourage research in problems relating to mental hygiene and corrective education.

Pyrite in Western Pennsylvania.—An investigation of the pyrite resources of Pennsylvania has been undertaken by the state geologic survey, and it is stated that, according to present prospects, an abundance of pyrite can be produced in the bituminous coal area, especially in the Pottsville and Allegheny series coal around the north and northeastern margin of the bituminous field. There is an urgent need of this substance for use in the production of sulfuric acid, the demand for which has enormously increased since the beginning of the war, while the supply of Spanish pyrite, formerly the source of 40 per cent of the production, has been much curtailed. Pyrite or marcasite occurs in the coal beds as "sulfur balls," and has not generally been saved heretofore in coal mining.

The New Zealand Journal of Science and Technology.—The Government of New Zealand has taken the novel step of establishing a popular scientific journal, which bears the foregoing title. It is to be published quarterly, under the editorship of a number of representative scientific men of New Zealand. The new journal will include short popular articles on scientific subjects of interest to the public at large, thus supplementing the more detailed and abstruse reports of the scientific branches of the government. The initial number of the journal contains, among other interesting articles, an account of the utilization of the waters of Lake Coleridge as a source of electric power for the city of Christchurch; the first large-scale hydroelectric undertaking in New Zealand. This installation has been running since March, 1915.

Electricity

Slow Motor Speeds.—Speeds below 600 are known as slow speeds for electric motors. It is in this range that many low head centrifugal pumps operate. Induction motors are by no means adapted for these speeds. In fact, continues *Electrical Engineering*, the efficiencies are generally low and the power factor also, so that the tendency in the past has been to use some method of belt or reduction gearing. The synchronous motor, on the other hand, by the very nature of its characteristics is perfectly adapted for direct connection on slow speed work. The efficiencies at these speeds are remarkably high and the efficiency curve is quite flat, falling off only a small amount for part loads.

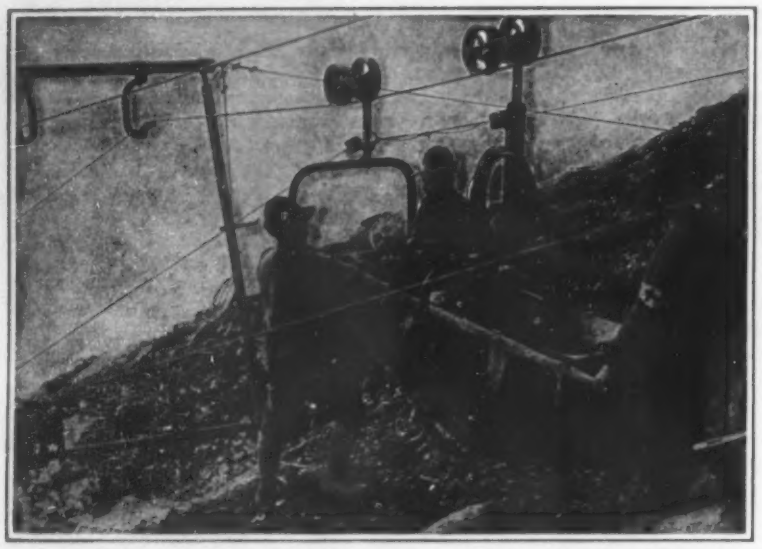
An Electrical Rubbing Machine.—A motor-operated rubbing machine for woodsurface finishing has been developed recently by an American concern. The device is operated by a fractional horse-power motor which moves the rubbing blocks together and apart at an even speed. The speed is governed by a regulator which can be varied according to the class of work to be done. The machine is inclosed in a dust-proof aluminum case and weighs about 35 pounds; and while this weight gives sufficient pressure for ordinary purposes, additional pressures can be applied by the operator if it is desired. The device is used for rubbing surfaces 15 inches in length and of practically any width.

Compact Electric Lantern.—Measuring but 6 by 5½ inches, an electric lamp recently placed on the market is available for quite general use. The case is made of heavy metal thoroughly nickel-plated. A standard low-voltage tungsten lamp is used, well protected by a wire guard. A bail serves as a handle and the hook on it permits it to be hanged on a rod, nail or hook. The bail can be rotated, so that the lantern may be turned to any angle desired and carried upwards, downwards or sideways. With the dry battery used in this lamp it will give about twenty hours' continuous service and about forty hours' intermittent service.

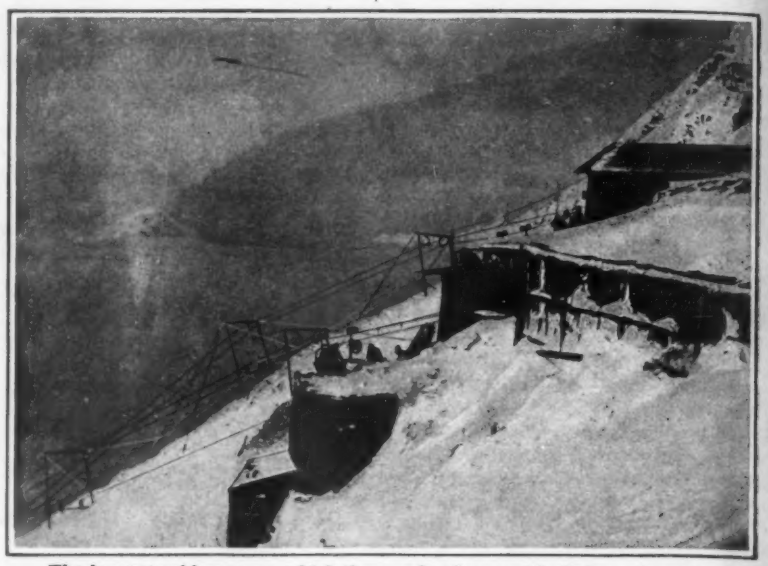
Electrolytic Generators of Norway.—Large generators are being employed in Norway in connection with the electrolytic work of an aluminum company of Christiania. The units are of 3,000 kilowatts, and are water-wheel driven, each generator being capable of variation in pressure from 50 to 335 volts. Their most interesting feature, however, is the fact that as much as 12,000 amperes is handled by one commutator operating at 3,000 revolutions per minute. Special ventilation is provided by hollow brush brackets, supported at each end by brush rings, also hollow. The brackets are so shaped that a jet of air is forced radially from them in front of each brush. The machines are of the shunt-wound, interpole compensated type, designed with a large proportion of copper and relatively little iron, so as to diminish the weight to an absolute minimum.

An Electrical Engraver.—An engraving device which operates by electricity is now being marketed by a Rhode Island concern. This engraving outfit makes use of two available range transformers enclosed in an oak case. The main set of wires leads to the copper electrode which does the engraving; a second set leads to a manually controlled switch, located near the point of the pencil. In using this device the forefinger rests upon this switch, the switch remaining open while the writing or engraving is going on. When the operator wants to raise the pencil from the work, he presses the switch with his finger and breaks the current to prevent flashing or arcing. The second set of wires which is controlled by the small connecting switch on the pencil, runs back through the instrument board into the interior of the device. On one side dry cells are interposed to give a direct current for operating a circuit breaker fastened to the side of the cabinet. Writing with this device, say the makers, is as easy as writing in the usual way on paper with a pencil.

Increasing Carrying Capacity of Underground Cables.—The carrying capacity of electric cables depends primarily on the heat developed in the passage of the current and the thermal resistance of the surroundings; *i. e.*, the resistance offered to the conduction of the heat developed. With a copper cable of specific dimensions and a certain current, the first element is fixed; but there are still possible methods of improvement in regard to the second. If, for example, the duct surrounding the cable could be filled with some suitable insulating material, offering considerably less thermal resistance than air, this would be an advantage. In a recent article in the *Electrical World*, Mr. E. O. Schweitzer describes an experiment in which the substitution of crude vaseline for air in a cable duct was found to diminish materially the thermal resistance and corresponding temperature elevation. It remains to be seen whether on a large scale vaseline is a suitable substance for use in this way; but it is possible that some economical substance may be found for replacing air in underground cable ducts, thus increasing the safe electric carrying capacity of the cable.



Evacuating the wounded from an exposed mountain position in a stretcher transported by aerial wire



The longest cableway, on which thousands of men with their equipment have been carried up an unscalable peak

The Teleferica

The Military Cableways of the Italian Alps

ONE of the greatest difficulties which the Italians have had to contend against is that of a suitable means of transport for men, guns, and material, more particularly in the high Alps. Many and elaborate have been the devices which have been resorted to, prominent among which is the teleferica, or cableway. Indeed, this wonderful contrivance played a very important part in enabling the Italians to hold successfully their 300 miles and more of high Alpine front during the first two years of war. And in this connection it should be borne in mind that the Austrians were never able to break through upon the Alpine front, where—until the debacle upon the upper Isonzo—the Italians, peak by peak, valley by valley, were slowly but surely pushing the enemy backward all along the line. Nor should it be forgotten that up to the very last the Alpini had their traditional foe mastered along all that 150 miles of sky-line positions—from the Carnic Alps, through the Dolomites to the Trentino—which ultimately had to be abandoned only because their rear was threatened by the Austro-German advance along the Friulian plain from the Isonzo. The loss of this line under these conditions, therefore, detracts no whit from the magnificent military skill and heroism by which it was won and held.

The Italians' conduct of their Alpine campaign must remain a supreme classic of mountain warfare—something which has never been approached in the past and may never be equalled in the future. According to the most approved pre-war strategy, the proper way to defend mountain lines was by implanting guns on the heights commanding the main passes and thus rendering it impossible for an enemy to traverse them. The fact that these commanding positions were in turn dominated by still higher ones, and these latter by others, until the loftiest summits of the Alps were reached, was responsible for the struggle for the "sky-line" positions into which the Austro-Italian war quickly resolved itself.

This kind of war would have been a sheer impossibility two decades ago, from the simple fact that no practicable means of transport then existed capable of carrying men, munitions, guns and food up to continuous lines of positions from ten thousand to thirteen thousand feet above sea-level. The one thing that made the feat possible was the development of the aerial cableway, or the teleferica, as the Italians call it, which gave transport facilities to points where the foot of man had scarcely trod before. Regular communication with the highest mountain-top positions would have been absolutely out of the question without this ingenious device.

In principle the teleferica is precisely similar to the contrivance by which packages are shunted around in the large stores and factories. The only point which differentiates it in the least from the overhead ore-tram-

Italian engineer working his way up a sheer cliff to establish a cableway

ways is the fact that—in its latest and highest development—it is lighter and more dependable. For the ore-tramway—always built in a more or less protected position—has only the steady grind of the day's work to withstand; but the teleferica has not only the daily wear and tear racking it to pieces, but it is also in more or less perpetual peril of destruction by flood, wind, and avalanches, to say nothing of the fire of the enemy's guns or of bombs from his airplanes. That the Italians have evolved a contrivance more or less proof against the ravages of these destructive agents is, perhaps, the best evidence of their genius for military engineering. Nothing more perfect in its way than the teleferica has been produced by any of the belligerents.

Theoretically, a teleferica can be of any length, though the longest on the Italian Front is one of about four miles, which makes a good part of the 8,000-foot climb up to the summit of the Pasubio, in the Trentino, and which, at the time of writing, is still in Italian hands. The cable may run on a level—as when it spans some great gorge between two mountain peaks—or it may be strung up to any incline not too great to make precarious the grip of the grooved overhead wheels of the basket. Although engineers have stated no limit here, no teleferica is in operation with a cable running at an angle of over 45 degrees. Wherever a cable does not form a single great span it has to be supported at varying intervals by running over steel towers to prevent its sagging too near the earth.

A teleferica has never more than its two terminal stations. If the topography of a mountain is such that a continuous cable cannot be run the whole distance that it is desired to bridge by teleferica, two—or even three or four—separate installations are built. This is well illustrated in the ascent of the Adamello, the highest position on the Austro-Italian Front. One goes to the lower station of the first teleferica by motor, if the road is not blocked by slides. At the upper station of this two-mile-long cableway, a tram-car pulled by a mule is taken for the journey over three or four miles of practically level narrow-gage railway. Leaving this, a 100-yard walk brings one to another teleferica, in the basket of which one is carried to its upper station on the brow of a great cliff towering a sheer 3,000 feet above the valley below. Three hundred yards farther up another teleferica begins, which lands one by the side of the frozen lakes at Rifugio Garibaldi. Three more telefericas—with breaks between each—and a dog-sled journey figure in the remainder of the climb to the glacier and summit of the Adamello.

The engine of a teleferica—its power varies according to the weight and capacity of its basket and the height

(Concluded on page 58)

A long span of the "teleferica"

Taking up a gun to an advanced position

Fifty Billion German Allies Already in the American Field

Pests Already Intrenched to Destroy $1,000,000,000 in Grain This Summer

THAT the United States is already invaded, not by Germans, it is true, but by their effective allies, and that a great host of these are intrenched in the grain fields, is an assertion hard to believe at first. Nevertheless, it is strictly true, for the cinch bug is pro-German in our present war, the Hessian fly is still Hessian, and the army worm is an ally of the Germany army. Our duty of helping to feed our fighting friends being paramount, that of protecting and defending the food supplies we produce is as essential as is production itself.

As a matter of fact, incurring the expense of producing crops and then letting them fall a prey to our insect enemies is worse than not producing them at all, and the official entomologists of the different states are being mobilized for special service in crop protection. These men are but a handful, however—not enough for an efficient patrol—and so they are calling upon the people for assistance in keeping watch for the common enemy and reporting the first traces of his appearance in numbers sufficient to threaten serious injury.

What these field insects are capable of in the way of crop destruction is fairly well known, and what the farmer may do for the protection of his crops can best be intrusted to the hands of the various state entomologists, whose business it is by bomb, gas and other means to kill these allies of the foe.

Consider two fields of corn, both lying next to heavily infested fields of wheat. One is protected by a circle of oil about its borders. The other is unprotected. The unprotected corn is entered without hindrance by the insects as the ripening of the wheat deprives them of food, and a large part of the corn is destroyed. In the other field not a hill of corn is hurt. The road-oil poured upon the ground in a line between it and the infested wheat catches the bugs which seek to pass.

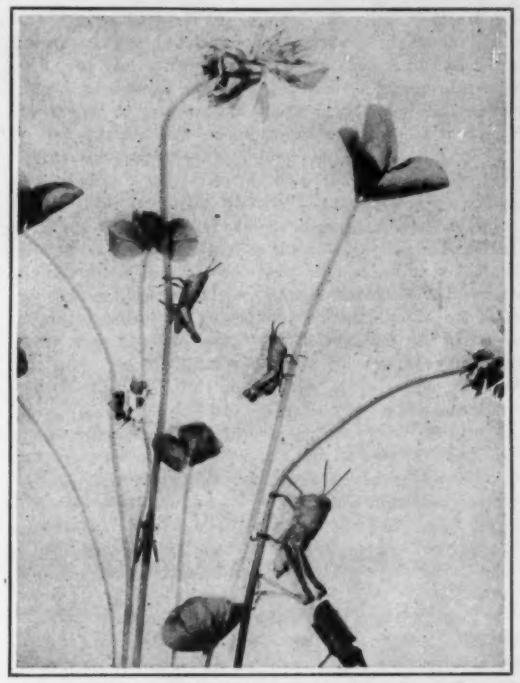
By a somewhat general use of such methods, in 25 southwestern counties of a middle western state, during a cinch-bug uprising last summer, more than 1,500 miles of barrier were laid down between corn and infested wheat. A million dollars worth of corn was saved from destruction at a total cost to the owners of less than $50,000 and of some $10,000 to the state. On the other hand, wheat, oats and corn worth at least $13,000,000 more were lost during the same period for lack of sufficiently general and thorough-going action.

Owing to a consequent scarcity of feed many farmers were unable to keep up their stock, and in four infested counties, selected as a sample district for study in comparison with another group of counties not infested, the number of dairy cows fell off in four years 7.4 per cent; beef cattle, 21.5 per cent; hogs, 15 per cent; horses, 27 per cent. The total cash amount of this reduction in numbers of the live stock of the four sample counties, due solely to the presence of the cinch bug, was $1,053,818. Trade, banking, education, professional incomes and every kind of business and civic interest naturally suffered from this staggering blow to the agriculture of the region.

There is danger of a reappearance of this hostile insect horde in the country every year, and it is a duty which we owe not only to ourselves but to our country and to our allies in the war to see that nothing of the kind is allowed to get under headway if it can possibly be prevented.

The cinch bug does greatest damage to corn. The adult or full-grown bug is black and about one-eighth of an inch in length, and usually bears conspicuous white wings folded over its back. The young ones are bright red and wingless. The old bugs live over the winter hidden among clumps of wild grasses, especially those known as the "broom sedges," which grow abundantly in uncultivated places throughout the greater portion of the main wheat belt of the United States. It is most important, therefore, either to prevent these grasses from accumulating in waste or uncultivated fields or else to burn them over during the late fall or in the early spring, before the bugs have left the dry grasses and become distributed over cultivated crops.

It is the usual habit of the cinch bug first to attack fields of wheat, rye, or barley; and its presence often is unnoticed because the injuries inflicted upon these crops are obscure or of no apparent importance. About harvest time the bugs leave the small grains and crawl over the surface of the ground to the nearest fields of corn, where they begin at once to wreak severe injury. It is, therefore, very important that the presence of the bugs be detected before they have reached the corn and if possible before they have started to migrate from the small grains to the cornfields.



Young grasshoppers feeding on clover. In this stage they are easily poisoned

Cornfields may be protected and the migrating bugs trapped about the time of wheat harvest by plowing a deep furrow along the edge of the field, running the land side of the plow toward the field to be protected. In dry weather the side of the furrow can be made so smooth and the sides so steep that the bugs will find it easier to crawl along the bottom than to climb up the sides. Circular holes from thirty to forty feet apart, made with a post-hole digger, then may be dug in the bottom of the trench. Into these holes the bugs will fall in large numbers, and here they may be killed easily by sprinkling kerosene oil over them. In wet weather a line of liquid tar or crude petroleum, which the bugs will not cross, may be maintained in the furrow bottom. Spraying for cinch bugs has not proved successful except on a small scale and when conducted by an expert, the difficulty being that the substances which kill the bug are almost sure to kill the corn also.

The corn-root aphis, the cinch bug, and the Hessian fly (from left to right). All greatly enlarged

Another notorious insect whose function it is, in the order of nature, to take bread out of our mouths, is the Hessian fly, so called because the Hessian soldiers were believed to have brought it over from Europe during the Revolution. This pest gives its attention almost wholly to wheat, upon which it levies an average annual tax of approximately 10 per cent. Experts figure that 60,000,000 bushels was the shortage in the 1917 wheat crop of the country which may be charged up to this insect. And its members, increasing year by year, have deterred many farmers from sowing wheat, notwithstanding the rapidly rising market prices.

The Hessian fly is a minute mosquito-like fly which lays its eggs upon the leaves of wheat. These eggs hatch into little maggots which crawl down into the leaf sheaths. There they live upon the plant's sap, which they obtain by gnawing into the soft portions of the stem. Usually two, but sometimes three or more, generations of the insect occur during a year.

After the Hessian fly has once thoroughly infested the crops of wheat there is no known means of saving it, and the only known means of preventing damage from the fly is to keep it out of the wheat.

The remedies for the Hessian fly are, therefore, entirely preventive. One is to plow down the wheat stubble immediately after harvest in order to destroy the maggots which remain in it. This is for the protection of future crops. Another is to pay great attention to the preparation of the seed bed for the wheat by plowing early and working and packing the soil thoroughly in order to eliminate lumps and clods, thus producing a finely pulverized, compact, and moisture-conserving bed for the seed. Care should also be taken that the sowing of wheat in the fall is delayed until the fly-free date, information regarding which date can be obtained by applying to country agricultural agents or State experimental stations. Finally, a good rotation of crops should be practiced wherever possible, and the cooperation of the entire community secured in following these preventive measures.

The army worm, known as a pest of the farmer from early colonial times, and the locusts or grasshoppers, often multiply under favorable conditions to numbers sufficient to devour great areas of both grain and forage crops. Both may be killed easily if attacked in time by sowing broadcast among them a poisoned food which they prefer to the grain and grass plants on which they naturally feed. But this method requires, as a rule, early notice of the impending calamity, prompt organization of the communities concerned for self-defense, and general arrangements for the quick supply of all the necessary materials in wholesale quantities—all measures for which careful preparation must be made in advance.

In case the worms are not discovered until they have begun to travel in a mass, usually they can be destroyed by furrowing or ditching completely around the infested area. The worms will fall into the ditches and can be killed easily by crushing them with a log—hitched to a horse or mule—dragged back and forth through the ditch or furrow. Another method is to dig shallow post holes in the bottom of the ditch at intervals of about twenty feet into which the worms, crawling along the ditch bottoms, will fall. They can then be destroyed by crushing or other means.

After the marching army worms are trapped in this ditch, they are crushed by drawing a log back and forth over them

Other important insects of more constant numbers are the so-called corn root worm, which devours the roots of the corn plant, making a profitable crop impossible if corn is grown too many years on the same ground, and the corn-root aphis, which sucks the sap from the root with similar effect.

The cutworm injury, which usually consists in the cutting off of the plants at or a little below the surface of the ground, almost invariably occurs in the spring, beginning as soon as the first plants sprout and continuing until late June or early July, by which time the worms are full grown. The worms feed at night and rest during the day beneath debris or in soil from one-half to one inch below the surface, and since in most cases they resemble the soil closely in color the cause of the injury often is not apparent. Poisoned baits are effective when cut-

(Concluded on page 58)

Strategic Moves of the War, July 10th, 1918

By Our Military Expert

THE last two weeks have seen everything favorable to the Allies on all fronts. Beginning on June 23d the Italians gained one of the most decisive victories of the war and one that will no doubt have a great influence in future operations on that front. The Austro-Hungarian forces in Italy have had to admit defeat although they struck on the offensive with their maximum strength and power. Not only did the Italians hold their own on their mountain fronts but they routed most disastrously the Austrian army on the lower Piave River. On the mountain lines the Austrians ceased their offensive after two days' fighting and made no appreciable progress; on the Piave they had obtained a foothold on the Montello plateau—practically a junction point of the mountain and river lines; in addition, they had crossed the river to the south in three or more places and had penetrated the Italian trenches to a depth of three or four miles. The Italians, persisting in counter attacks, had driven the Austrians back almost to the river lines when a new danger for the latter arose from heavy rains and consequent floods that washed away bridges and rendered the river impassable by fording or otherwise for some days. The enemy was therefore unable to obtain supplies of fresh troops; as a consequence, when the floods subsided, a retreat under the most trying disadvantages was begun.

The result was a great Austrian disaster, terminating finally in a complete overthrow on this part of the line. The river, so easily crossed in the advance, became, as is always the case under such circumstances, a dangerous enemy—one equally as great as the Italian army itself. It contributed its share to the Austrian loss in men, guns and material. The estimate of the loss in men alone has varied from one to two hundred thousand; the former amount is admitted by the Austrians and the latter is claimed by the Italians. At any rate, the defeat of the Austrians was complete.

This battle of Northern Italy may probably prove the turning point in the year's campaigns. It has been won by the greatest courage, unity of effort, and excellent generalship. On the part of the Austrians, it was lost through over-confidence, too ambitious strategy, and wretched coördination between the armies representing a government in the last stages of military disorganization. The condition of the country, as well as strategical and tactical requirements, has prevented any extended pursuit in the lowlands of the Venetian plains; but, on the mountain fronts, every effort has been made to widen out the most threatened portions of the Italian front by "nibbling operations." This has been especially true on the Asiago plateau, where commanding points have been taken, especially those controlling the entrance into the Frenzela valley that leads from the mountains to the Brenta River and on to Bassano in the plains country.

This Frenzela ravine or valley is the eastern road from the Asiago plateau to the valley of the Brenta; for the Austrians, it is the short cut from their lines on the plateau straight down to the Italian lines of communications. After last year's defeat of the Italians on the Isonzo, the Austrians endeavored to force a passage here and they were held only by superhuman efforts on the part of the Italian army. Ever since that time, the enemy has threatened this gateway to the rear of the Italian lines; but the recent capture of the commanding heights has placed him at last in a bad position. These heights, the Val Bella and the Col Rosso, completely intercept any effort to use the Frenzela valley for a descent to the plains country. They dominate the Asiago plateau from the east and, in a measure, the Brenta valley to the west; the magnitude of the Italian successes in gaining these positions grows as the campaign develops from day to day. Northwest of Monte Grappa on the Italian mountain front, the Italians have also wrested several important tactical positions from the Austrians. Each day brings news of successes—minor it is true, but, in the aggregate, having great influence on the situation.

On July 6th the Italians ended a five-day drive in the delta of the Paive River by forcing the last remaining Austrian troops across the main channel of the river and thus completely reëstablishing the battle line as it was before the Austrian advance began. They also took quantities of Austrian guns and war material and recaptured almost intact the guns and supplies that were abandoned when the Austrians made their first rush. Up to the present time, the capture of 25,000 Austrians is also claimed as a result of the Italian counter offensives. Austria-Hungary appears to have recognized her defeat in many ways, the principal one being changes in the chief commands of the army serving in Italy; General von Buelow, the Teuton commander who contributed most in bringing about the Italian disaster on the Isonzo, is said to be in control, thus showing Austria still more in German leading strings in conducting military operations. However, the initiative has been seized and held by the Italians, as shown by the gains on the mountain and river fronts. But these gains are as significant in a negative as in a positive way for they show that Germany is not now able to come to Austrian aid as she has always done in the past. Whenever Austria has heretofore had to face defeat, Germany has always sent men and commanders to her aid, as was illustrated on the Isonzo where German shock troops replaced Austrians and led the advance. But now, except as to a commander, she has failed so far to come to the aid of her ally at this critical time—a most significant fact as it indicates of course the constantly increasing need of the Germans to husband their men and to hold them for their own operations. This seems to show also that the German leaders have plans of their own that they regard as much more important than an Austrian success or failure on the Italian front. On the other hand, the Italian gains have shown that Italy can hold her own and will require little or no assistance from her Allies in troops provided she can receive provisions and supplies in quantities sufficient for her needs. Her successes must also remove many causes of anxiety to the Allied commanders who have so many problems to consider and to prepare for on the western front and who now feel that Italy can be left to her own resources.

In France, the Germans have been busy not only in preparing for the next drive, but also in making every effort to deceive. By marching and counter marching troops, by raising dust clouds to simulate troop movements, and by lighting bivouac fires at night in order to lead to the belief of the great concentration of troops

The German advance toward the Arctic

at certain points, they have attempted to distract attention from the obvious fact that their arrangements for the next advance are not yet completed. The question discussed everywhere is whether the French or the British will bear the brunt of the attack when it comes. In general, British military observers believe the next German effort will come north of the Somme River, having the Channel ports largely as the main objectives; French critics on the contrary believe that Paris will again be Ludendorff's aim. At any rate, it is hardly probable that the French commander and his staff will permit any surprise attack, such as that on the Chemin des Dames and the Aisne. On some parts of the fronts exposed to attack, the enemy has not disclosed his artillery positions for fear of the Allies finding where they are. This month has been credited with being the crucial one for offensive operations and it is believed the enemy's plans are being formulated with this in mind.

But today not only must the Germans defeat the British, French and American troops, but such a victory must be gained as will offset the Austrian disaster in Italy. The victory must be a decisive one and not one such as the Somme, the Lys, or the Marne that have led to no conclusions; in addition, stronger forces of the Entente Allies now confront the Germans than ever before and this strength is growing daily. In case of failure it can be stated as a certainty that German intitiative will have gone—never to return. The French and Americans appear to have found recently one part of the German line that is vulnerable; this is that portion of the lines extending from the Aisne to the Marne at Chateau Thierry. Here for some days the Allies have been pushing the Germans back and straightening out troublesome salients at various points. The advances made in this sector are important because the Allies are gaining commanding positions northwest of Chateau Thierry and a few more such thrusts will no doubt cause the abandonment of that town by the Germans. There have been seven or eight of these attacks in the past week that have resulted in a gain of 20 miles of front and in the capture of five or six thousand of the enemy's troops. All of the Allies' attacks have generally been brief, sharp, and upon relatively isolated advanced German positions. At times, these attacks have been to straighten the lines; at others, to gain observation points or to determine whether a German position had been strengthened or whether it concealed any large force being massed.

But for days now, the Germans have themselves been entirely inactive as regards offensive movements; except for the opposition made to the local successes of the Allied troops, they have been unusually quiet, so far as their own counter attacks are concerned. This may be purely deceptive and is certainly only temporary. They must attack sooner or later and the earlier the better as regards the arrival of allied reinforcements; our own troops are coming into the front lines in constantly increasing numbers that must be a source of concern to the German commanders. But the German delay in beginning the fifth drive may be due to another reason—*i. e.*, the enormous number of casualties that have occurred since March 21st, the date of the beginning of the first offensive of this year. It has heretofore been thought that four or five hundred thousand men was the price paid for the 25 miles of advance toward Paris and the Channel ports. But later information leads to the belief that the number of casualties went as high as eight hundred thousand, though, of course, many slightly wounded have probably already returned to the lines.

Where these attacks will fall no one can tell, but they will undoubtedly be renewed on the western front. So far the attacks near Compiègne and Chateau Thierry have disclosed no great massing of troops on that front; it can therefore be inferred the attack will come east of that front towards Rheims or Verdun or west toward Amiens or further north. A drive on the eastern front would indicate Paris as the objective—one towards Amiens or further north would indicate the Channel ports. Certainly the three logical points for attack are first in the vicinity of Chateau Thierry, second towards Amiens and Abbeville, where a German penetration would shut off the Allied lines upon a peninsula bounded by the Channel on the north and west and by German lines on the east, and third, north of Arras to obtain possession of the ports of Boulogne, Calais, and Dunkirk.

A new problem has recently arisen for the Allies and one that will no doubt call for early action. This problem is military intervention in Russia in view of present conditions in Siberia and of developments of the efforts of the Germans, aided by Finland, to take possession of the Murman coast of Russia and to gain control of Archangel and of the White Sea to the Arctic Ocean. In Siberia, the Czecho-Slovaks, who were Austro-Hungarian prisoners of war and deserters interned in Siberia, have armed and organized themselves and have become a valuable asset to the Allied cause. In a measure, they have reëstablished an eastern front by routing the Bolshevist forces, by taking possession of Vladivostok with its military stores and by securing most vital parts of the Trans-Siberian railroad. They have in reality organized a frontier for military purposes that could exert a pressure to drive the Germans out of Russia—and this frontier is now practically five thousand miles west of Vladivostok in the Ural mountains. In case of allied intervention, there would be no organized opposition to an advance of their troops from Vladivostok to the Urals.

As regards the Murman coast in the Arctic, German troops are reported as advancing toward the railroad running from Petrograd to Kola and the port of Murmansk; the Germans are also reported as having submarines in the White Sea. The reason for the advance toward Murmansk is because that port at the Arctic end of the railroad is ice-free almost the entire winter, due to the Gulf Stream making the climate much milder than it would otherwise be. The town itself has been an outgrowth of the war and through it has passed a large part of the supplies brought into Russia. Large quantities of military stores are said to have been landed and collected on the Kola Peninsula and it is for this reason, the possession of Murmansk is deemed so important. Allied troops and ships are reported as now at the port, but whether in sufficient strength to offer serious resistance to German forces, is not known.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Military Shotgun

To the Editor of the SCIENTIFIC AMERICAN:

Referring to article in your issue of May 11th, entitled "The Shotgun's Debut as a Military Weapon," it appears to the writer that the designer of this gun has made a great mistake in constructing it in such manner that the line of greatest dispersion is horizontal instead of vertical. This looks very well on paper, but will not hold good in practice. The writer has talked with a number of old Confederate veterans, some of whom had made frontal attacks on fortified positions, charging against the rifle's muzzle, and they, one and all, stated that while it seemed impossible for anyone to live to reach the breastworks, they had done so, and came to close quarters, because the soldiers in the trenches shot too high. In the present war, more men are killed at 500 yards range than at 100, and when the attacking party has passed the 100-yard range, it is practically safe from rifle fire. In view of these facts, it appears that the new shotgun should have been designed to disperse its load nine feet vertically and three feet horizontally. It is a case of practice against theory. If a veteran soldier persists in firing too high, why should not the gun be made to suit his known limitations?

A compromise between the two methods of dispersion mentioned, would be the conical dispersion and circular registration on a vertical target secured by a cylindrical bore. However, if anything is to be learned by experience, it would appear that a gun registering nine feet vertically and three feet horizontally would be the most effective weapon yet devised for close quarter and night raiding.

——— ———, PRIVATE.

Camp Doniphan, Okla.

Stripping the Shell-Band

To the Editor of the SCIENTIFIC AMERICAN:

I read your article on "Shrapnel Manufacture and Test" in the SCIENTIFIC AMERICAN of April 27th with much interest.

Having had some experience in the manufacture of shells, I suggest the following reasons for the copper band being sometime found driven forward from the band score.

When a band which is narrower than the band score is put on a shell and then drawn through a die it is not only drawn in a direction opposite to the direction of the press plunger but is forced forward. The metal flows in the direction of least resistance which directions are in both instances parallel to the shell.

This drawing of a band on a shell is somewhat analogous to the drawing effect a band must have when forced through a gun barrel since the copper band is a little larger than the diameter of the bore.

There is this difference however, in that in drawing the band as above described through a die, the shell is forced through carrying the band with it allowing the band to spread in width in both directions, while in the case of the shell in the gun, the gases not only force the shell forward but also force the band and since the inertia of the shell is to be considered, it looks reasonable to me that the soft copper might be forced forward ahead of the band score before the inertia of the shell is overcome and the shell put into motion.

WILLIAM R. WARD.

Bethlehem, Pa.

That Question of Nose Spin

To the Editor of the SCIENTIFIC AMERICAN:

Mr. George W. Williams, in his article regarding the motion of an airplane in its nose spin, when out of control, attributes its motion (reverse to the propeller motion), to the torque of the propeller coming before the engine is stopped. This may have its influence, but it seems to me that the propeller when at rest, or slowly rotating on the downward plunge with its bevelled surfaces, turns the air current to a reverse twist against the broad surface of the wings causing the whole plane to turn in the reverse motion.

To obviate this, cannot a lever be devised to bring into action enough air resistance, by ailerons or otherwise, to counteract the twist? Otherwise the only way seems to be, to immediately straighten out the rudder, and raise the tail, to bring the machine out of its dive in a spiral course, as it is likely to do, if not too near the earth. Then start the engine, as in a rise from a nose dive.

As an observer only, I pass this on to experts for what it is worth.

EDW. S. CHAPIN.

Cambridge, Mass.

The Amazing Case of General Wood

To the Editor of the SCIENTIFIC AMERICAN:

Concerning the "Amazing Case of General Wood" which you so ably discuss in your editorial of June 15th, I should like to make the following comments:

1. The latest injury done General Wood has sunk deep into the American memory, where it will be added to the long list of indignities already heaped upon America's foremost, ablest and most prophetic soldier. None need doubt that there is accumulating an explosive charge that needs only a slight psychological shock for its release. Then—when the hour strikes—this man who is foolishly thought to be interned and obscured in Kansas will be carried into power and action upon the shoulders of the populace. At the moment many mouths are closed whose owners have clenched fists in their pockets.

2. This leads to the subject of reactions. To those who would punish Wood for the deadly accuracy of his forecasts and the precision of his recommendations, it should be pointed out that, pushed too far in one direction, the American people will go as far in the opposite direction. The lesson which should have been marked by all men having pacifist tails is to be found in the reception recently given Mr. Bryan in Canada by returned Canadian soldiers. Bryan was (and still is) of the cult that has persecuted Wood. What Bryan met in a Canada converted to the doctrines of Leonard Wood, his cult must be prepared to meet in an America awakened to the costs of a persistent denial of those doctrines, and to the injury done it by the sacrifice of him who cried out that America ought not to be led into the valley of death, its hands empty of weapons.

3. But why, ask the simple ones, should such a man be kept from the front in this grave emergency? Why, my dear children, but

(a) To prevent truths being told if things be not right, and

(b) To insure that so great a soldier shall be *not* put in the way of victory, lest he return a possibility for 1920. Your schoolbooks will tell you that out of our wars have invariably sprung presidents—from the Revolution, Washington; from 1812, Jackson; from the Mexican War, Taylor; from the Civil War, Grant; from the Spanish War, Roosevelt; from the Great War—but here the powers-that-be slam the door and reassuringly whisper to themselves, "It shan't be Wood, anyhow!"

HENRY A. WISE WOOD.

New York Yacht Club.

Armor Plan of "Queen Elizabeth"

To the Editor of the SCIENTIFIC AMERICAN:

I read with interest the article appearing in the April 13th issue of the SCIENTIFIC AMERICAN in which various characteristics of the English "Queen Elizabeth" class were discussed, and in which it was stated that the armour thicknesses were not known. I have now at hand the war issue of the *Taschenbuch der Kriegsflotten* edited by Kapitanleutnant B. Weyer, of the Germany navy, which was published in October, 1914. In this the armor thickness is given as 343 millimeters (approximately 13½ inches), at the water line. This thickness does not, however, extend further forward and aft than the vicinity of the foremost and aftermost turret, from where only the water line is covered by an armor belt 152 millimeters (approximately 6 inches), thick, which stops about 29½ feet from the bow and stern. Below the thicker belt there is an armor protection 51 millimeters thick (about 2 inches), which completely covers the bottom of the hull. Above the water line the armor has a thickness of 254 millimeters (about 10 inches), and above that it dwindles to 203 (a little over 7¾ inches). The armor covering of the turrets is given as 356 (nearly 14 inches), and the deck covering at 70 millimeters (2.7 inches).

New York City. E. A. THROCKMORTON.

A Meteor Observation

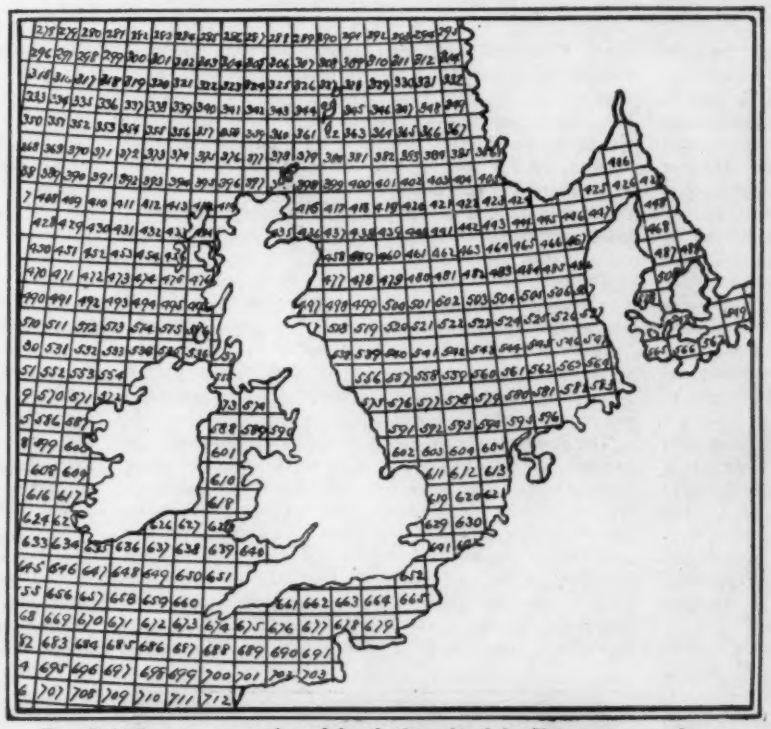
To the Editor of the SCIENTIFIC AMERICAN:

On the evening of April 23d, last at 8:30 a meteor of unusual splendor passed over the States of North and South Carolina, passing from north-west to south-east. To those who witnessed the full path it must have been a grand sight. I was not so fortunate as to see it, but at a point where the rock exploded a cloud was left in the sky, motionless in its great height above all air currents. This cloud lasted fifteen or twenty minutes after the main train of smoke passed away, so I took the advantage for triangulation to ascertain its height above the earth. Reliable data from Charlotte, N. C., and Greenville, S. C., giving the angle of elevation and azimuth as seen form these points were used to triangulate the height and position of the main explosion. The result shows that this cloud was 60 miles above the earth at a point in the zenith five or six miles beyond Blacksburg, S. C. An observer at Blacksburg says he saw the cloud nearly overhead, which verifies the above.

Measurements for the dimensions of the cloud show that it was about five miles long and 2.5 miles wide. The barometer proves that one half of the air is within three miles of the earth. What it is at 60 miles we do not know but it must be very rare, yet the velocity of the meteor was great enough to burn the rock, melting and vaporizing part of the iron which is its chief constituent.

I observed this cloud as if in the white light of the noon day sun, 32 minutes after the sun had set at Blacksburg so it was far above the sunset tints, as the rays from the setting sun passed over this point something over 27 miles, in our latitude at this time of the year. No report has been received that any part of the meteor reached the earth. If not consumed in heat, it may have fallen in the Atlantic.

SPARTANBURGER.



How British waters were keyed for the benefit of the U-boat commanders

A Map for German Submarines

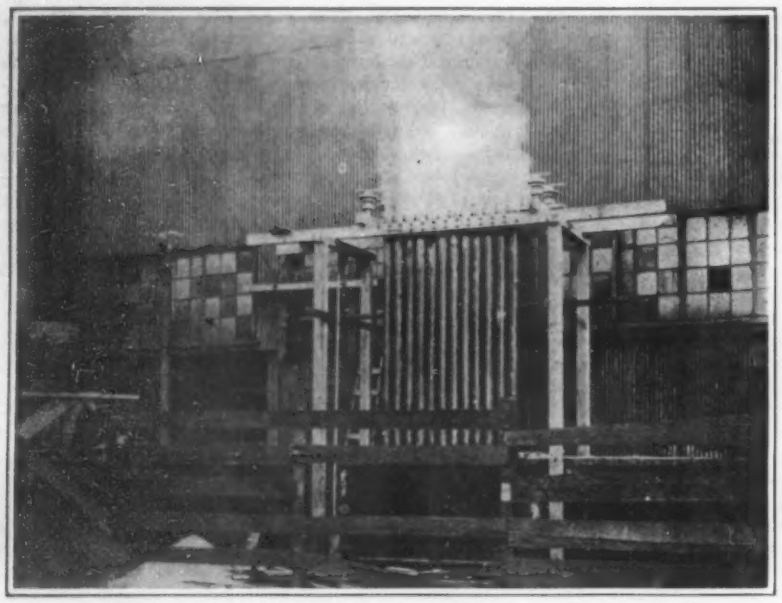
THE above map with its numbered squares is a reproduction of part of a German map discovered in Norway and lately released for publication by the French censor, and shows how the German navy plotted the North Sea and English Channel for the use of its submarines.

By the use of a special code the departure of every vessel, its tonnage, speed, route and whether it was a ship of commerce or of war, was wirelessed to the submarine by spies in certain coast towns of the adjacent waters. Mr. Henry Barby writing in *L'Illustration* gives the following translation of this code, and as it will be seen it is so designed that every message shall seem to refer to some innocent commercial transaction.

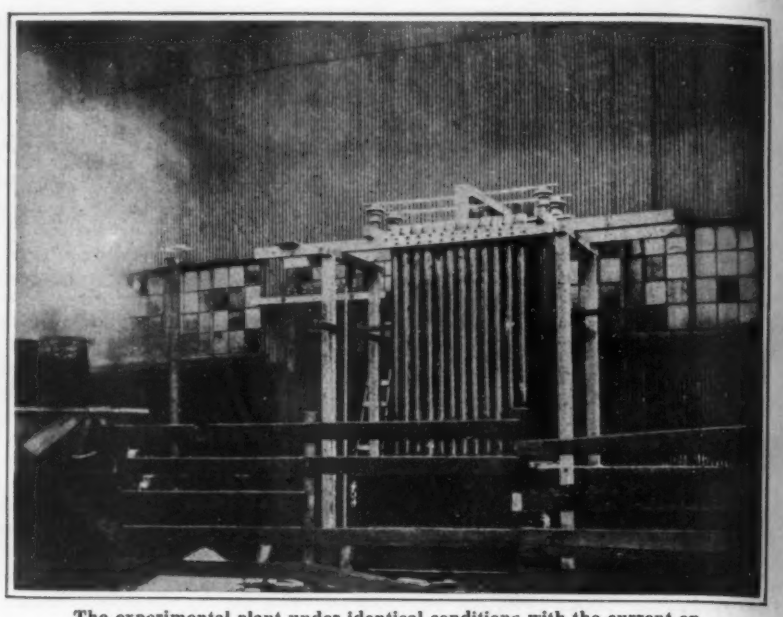
The nationality of the vessel is indicated by first, second, third or fourth quality, meaning in that order, British, German, French, or Russian, while neutral shipping is designated by colors, such as Norwegian, painted black; Swedish, painted blue; Danish, painted red.

The description of the vessels is designated in the following way. "Wooden Box, Series 1, means a warship with one smokestack. Series 2, two smokestacks, and so on. Packing case, Series 3, means armored crusier, three smokestacks. Metal box, Series 2, 3, or 4, means light cruiser, two, three or four smokestacks. Barrel, Series 2, 3, or 4, means destroyer, two, three or four smokestacks. Barrel, Series 1, means a torpedo boat, while the submarines are designated as "samples" and mines as "packages." The position of the boat is indicated by the number of the square on the map; thus a wireless reading "First quality packing case, Series 4, No. 432," translated is "British armored cruiser, four smokestacks, in square 432."

The discovery of this map and the translation of the code quickly led to the discovery of the wireless stations which were being used by the German spies, and it is said that this discovery and the use the Allies put it to, accounts in no small measure for the falling off in the list of the U-boat victims.



Cottrell experimental apparatus in the cement plant, with current off



The experimental plant under identical conditions with the current on

Turning Smoke Into Money

The Origin and Development of the Cottrell Electric Precipitation

By Robert H. Moulton

AMERICA sends billions "up in smoke" yearly because of the enormous waste in the fuel used by our industries. On the other hand, there is a man in Washington who has discovered how to turn smoke into money and he is now busily engaged teaching the rest of the country how to perform the same trick. He does this by means of devices which, through electrical precipitation, not only reclaim vast wealth from the smoke, dust and fumes of smelters and other plants, but at the same time redeem thousands of acres of nearby land. As a matter of fact, the curb which he has put upon the smoke and dust nuisance—his original aim—now actually bids fair to be, in some directions, the primary reason for the running of certain of our industries. The smoke wizard who has accomplished these remarkable things is Dr. Frederic G. Cottrell, Chief Metallurgist of the Bureau of Mines.

Dr. Cottrell's experiments began several years ago when, as a member of the staff of the University of California, he was called upon to solve the problem of helping a smelter located on San Francisco Bay. The waste gases and vapors from this smelter, resulting from the sulfuric acid parting process used in treating gold and silver bullion, were declared a nuisance by neighboring farmers and seemed likely to provoke costly litigation and possibly lead to a shutdown of the plant.

The gases discharged into the air amounted to substantially 5,000 cubic feet per minute and held in suspension an important proportion of sulfuric acid in the form of a fine mist. The corrosive action of the acid, swept broadcast by the shifting winds, was felt throughout the entire zone and both the agriculturists and the people generally had ample reason for complaint. The smelter was a profitable one and the management was anxious to find some way to abate a nuisance that was both a menace to health and hurtful to vegetation.

Dr. Cottrell's preliminary work brought up some puzzling situations. Up to a certain stage matters went well enough on the miniature scale of the investigational tests, but beyond this was the question of meeting the practical situation presented by a large commercial smelter. A big part of Dr. Cottrell's achievement lay in spanning the gap between the laboratory and the industrial plant and in finding ways to control the enormous pressures of the necessary electric current, mounting up to 100,000 volts.

The problem was solved, however, and so well was the precipitator installed at this smelter designed that it has been doing its work satisfactorily ever since. Further, by mere chance Dr. Cottrell attacked at that plant what is commonly admitted to be the most difficult of all problems of smoke or fume abatement, viz., the precipitation of acid mist.

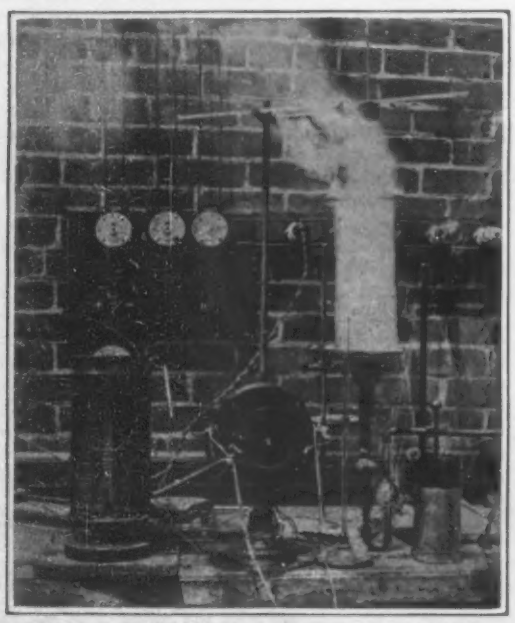
The good results obtained in this first instance soon became widely known and a new line of application was opened a few years later when a great California copper smelter was threatened with fume litigation by the United States Forestry Service. Fume, or fine particles in the form of smoke, and sulfur dioxide gas, invisible to the eye, given off from the stacks of the smelter, had swept the neighboring country bare of vegetation for miles, and it was a case of either a shutdown or a suppression of these destructive discharges. A full sized plant of the Cottrell type was, accordingly, installed. The volume of the gases treated averaged between 200,000 and 300,000 cubic feet per minute, and during the filtration tests made throughout a period of nine months it was found that the electrical precipitator recovered between 80 and 90 per cent of the suspended matter. With improvements in detail of construction, the efficiency later was raised well up into the nineties.

The general public has only the faintest notion of the wastage represented in the fumes and smokes from belching stacks, quite apart from the beneficent economies following from the abatement of outpourings harmful to man and vegetation. In the smelting of lead the fume contains anywhere from three to ten per cent of the volatilized metal in the form of lead oxide and lead sulfide, with compounds of arsenic and antimony. This percentage is well worth recovering. Dr. Cottrell is authority for the statement that during the smelting and refining of various ores, not less than 36 valuable substances are found in fumes which, if not collected, would be lost.

At Great Falls, Mont., there was at one time a daily loss in dust from the stacks of one of the large smelters of 3,775 pounds of copper, 106 ounces of silver, and 0.71 ounce of gold. By an adequate provision for dust recovery, this smelter was able to save in the course of a single year metallic values amounting to $130,263.

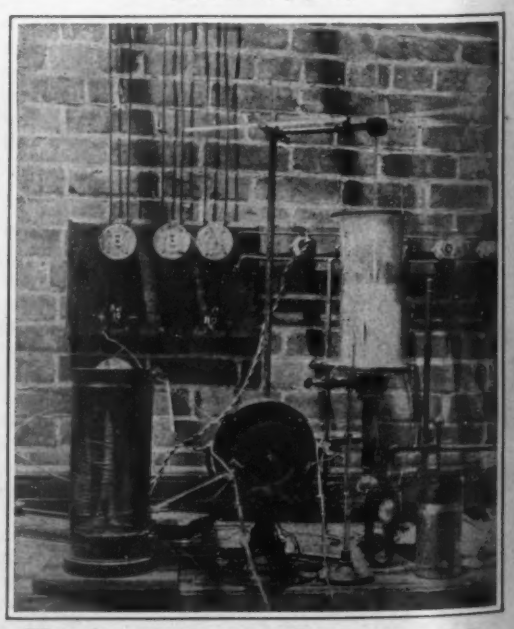
The blighting gas, sulfur dioxide, given off from the stacks of copper smelters can be transformed into useful substances by turning the gas into sulfuric acid or sulfur. Sufuric acid is largely made here by treating pyrites, and we now consume annually in the neighborhood of 6,250,000 tons of 50 per cent sulfuric acid. To a great extent this corrosive fluid is a prime constituent in the preparation of fertilizers, especially where phosphate rock is

(Concluded on page 59)

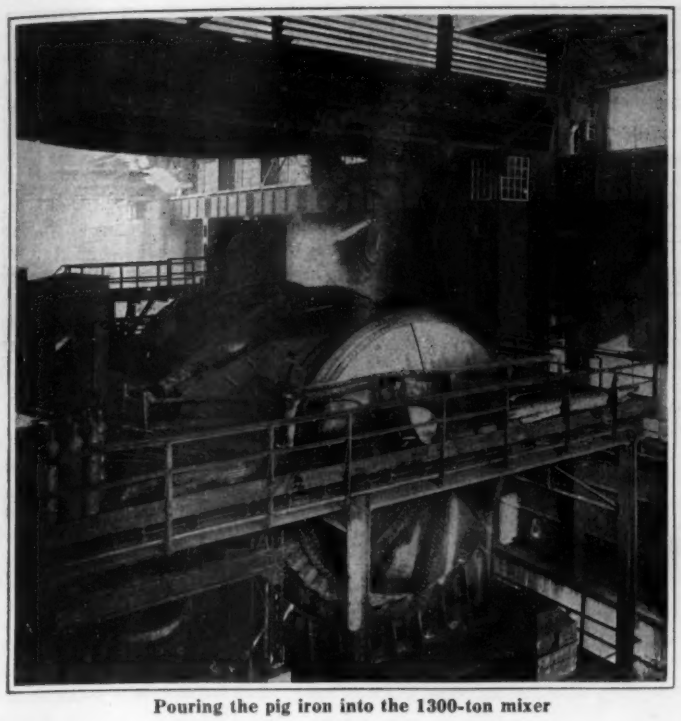


Fumes passing through the treater of the Cottrell apparatus, without current

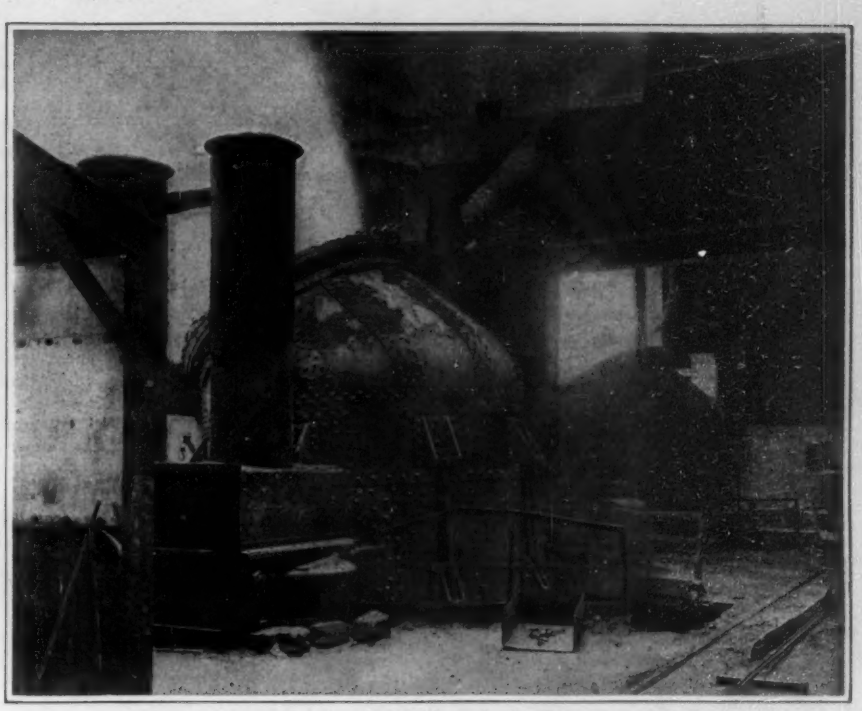
How dust from cement manufacture collects on vegetation and destroys all life



When the current is switched on the passage of the same fumes gives this appearance



Pouring the pig iron into the 1300-ton mixer



The metal from the mixer being blown in the Bessemer converter

High Grade Electric Steel

Pure Metal in Quantity by a New Process

QUANTITY output of quality steel is now the slogan in the steel industry—at least as regards the future. It has now been demonstrated that the highest quality steel, which is that now made in electric furnaces, can be made in large quantities in electric furnaces of large size. It is accomplished by what is known as the "Triplex Process." This is so named because it involves three steps in steel making. Pig iron is taken molten from a mixer and blown in a Bessemer converter which removes some of the impurities. The still molten metal is then transferred to tilting open-hearth furnaces where other impurities are removed, principally phosphorous. The third step is the refining of this metal in an electric furnace into which it is also poured hot from the open-hearth furnace. The successful manipulation and operation of 30-ton electric furnaces, the largest in the world, has made possible this new process which bids fair to revolutionize steel making.

Steel so made is the best that can be made but it has until recently been impossible to produce it in quantity. It has been demonstrated that it is a superior steel for rails and its production, now in quantity, may solve the steel rail problems. Such rails resist shock and breakage better than any others, especially at low temperatures at which electric steel is tougher than any other. It will also be valuable in airplanes, in guns and many other products.

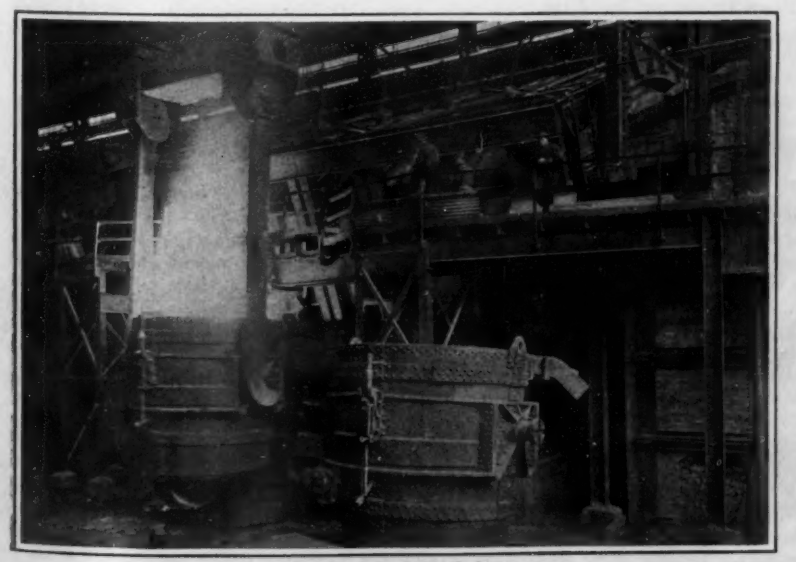
The four illustrations vividly picture the new triplex process at the plant of a big steel company, in South Chicago, Ill. It is the largest electric steel plant in the world. The hot pig iron is first of all poured into a 1,300-ton mixer from the blast furnaces. After this the same metal, mixed in the mixer from several blast furnaces, is blown in large 25-ton Bessemer converters. In the next step the molten steel from the converters is poured into the 250-ton open-hearth furnaces. After treatment in these, the partially purified steel, is tapped off into ladles which are taken to the electric furnaces and poured into these for the final refining which gives the finished product.

The Current Supplement

EVERYTHING connected with agriculture, and the increased production of food, is being given most careful attention in these days of increasing necessity in every quarter of the world; but there are many problems of plant life that are as yet little understood. Among these is included the physiology and energetics of carbon assimilation. Some consideration of this matter will be found in a paper on *The Green Leaf*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2220, for July 20th. *Bulb Growing* in the United States tells what is being done in this country in an industry which has for years been considered one of the monopolies of Holland, and the story is illustrated by several photographs. The striking cover illustration gives an idea of the wonderful engineering work accomplished by the Italians in their operations in the mountains of their Eastern front. *Fish Isinglass and Fish Glue* gives an account of the sources and methods of manufacture of materials largely used in the arts. The bombing of unfortified cities by the Germans appears to be actuated largely by malice, for the special objects of their attacks have been notable and historic monuments, with the purpose of destroying as many priceless works of art as possible. And in their terrestrial operations, from their titled officials to the meanest camp follower, they are as eager for loot as any barbarians in the history of the world, carrying off what they can and wantonly destroying everything else—an acknowledgment that they have no hope of permanently holding the territory occupied. The interesting account of *Rescuing the Art Treasures of Venetia*, with numerous original illustrations, is concluded in this issue. An article on the *Aland Islands* gives some valuable information in regard to this group of islands, of considerable importance in European politics. *The Sun's Equatorial Rotation* discusses an interesting, but neglected problem of celestial physics, and it accompanied by a number of diagrams. *Electrolysis Mitigation* deals with problems of great importance in the underground distribution of electricity, discussing the causes and methods of prevention. Other articles in this issue are *The Scientific Basis of Rationing; Where Our Birds Come From; Ironing Out Cracks in Iron* and *Changes in Oceanic and Atmospheric Temperatures.*

Fruit Pommace as Fuel

AT a recent meeting of the *Academie des Sciences*, Messrs. Matignon and Marchal set forth their researches upon the use of grape pommace as fuel, and this question is a timely one during the present shortage of fuel. In fact, attention is being called to various kinds of material which might be used in this way to a good advantage, and whose calorific power has a considerable value. They find that grape pommace when well dried is an excellent fuel and has a good heating quality. In their researches they find that the substance dried at 115 degrees C., shows 4,400 calories. They also show that as this substance has much resemblance to dried peat, it can be used in suitable producer gases, and it has an advantage over peat in that it can be dried rapidly. Combustion allows of recovering most of the phosphorus compounds and potash contained in the ash, and only the nitrogen is lost. A ton of well dried pommace has the same heat value as 0.4 ton of coal. By this estimate, the annual wine production of 1,250,000,000 gallons represents at least 175,000 tons of coal, so that the interest of this application is considerable. Pommace of other fruits could no doubt be employed.



Tapping the open-hearth furnace

Pouring the open-hearth metal into the electric furnace

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

What Do We Wear?

IT seems likely that the war may engender an interest in fabrics which it has been impossible to create in normal times. It is natural that innovations in foods should always excite comment for there is the direct effect upon health, besides economic considerations. Raiment, while second only to food in the list of expense items, never seems of primary importance and people have generally purchased with respect to style rather than to service.

Textile experts have repeatedly pointed out that even in normal times there is not enough new wool clipped to provide all of us with new all-wool garments, and still most people have thought themselves to be among the favored few. Extensive experiments have been conducted to prove the utility of short-fibered wool, reworked wool and shoddy while the service which cotton can give is not yet fully recognized by the public. The investigation of fabrics has become of interest to the chemist who devises accelerated tests in order that the behavior of raiment in service may be foretold with the greatest possible accuracy.

What is it in wool that gives it a reputation for warmth superior to that possessed by fibers of vegetable origin? Not merely the fact that wool is an animal fiber, but because it is so constructed as to entrap air in small spaces thus forming an excellent insulator. Called upon to decide the relative efficiency of wool and cotton provided with a heavy nap by mechanical methods, an apparatus had to be constructed for the test. This consisted of a copper vessel heated electrically, provided with thermostatic control and surrounded by an atmosphere artificially maintained at the freezing temperature. The fabric under test was wrapped about the copper vessel where it acted as an insulator, and the amount of electrical energy required to maintain the contents of the vessel at body heat was a measure of the efficiency of the cloth in keeping a wearer warm.

As a result of a series of tests it was found that cotton can be provided with a nap such that it will have seven-eighths the heat-retaining capacity of wool.

In some recent analyses of cloth to determine the fiber composition it was found that strong cotton thread had been wound with short fibered wool and then woven. This cloth had all of the appearance of wool, its warmth and "feel" together with the strength due to the cotton foundation. Now this cloth may become much more common and it is well to recognize that the combination is quite reasonable. Of course it should not be sold as all wool or even as wool mixture for that term may be so manipulated as to convey the wrong impression regarding the percentage of cotton present but the short wool would make a poor fabric unaided by the cotton, while the wool adds much of real value even if of short fiber or shoddy.

The war will continue to make it difficult for the world to clothe itself for besides obstacles to production there is an increased demand. An average of 65 pounds of wool per soldier is said to be required each year, and a simple calculation will indicate what that means. It becomes attractive therefore to provide new fibers and great effort has been expended to this end. Jute is to be found in various merchandise, generally woven with cotton. New kinds of cotton make their appearance and other vegetable fibers are the subject of spinning, weaving and finishing experiments. A refinement is the disguise of common fibers so they may serve in the place of more expensive ones, *i. e.*, cotton for linen and mercerized cotton for silk. There have been cases where 75 per cent of mercerized cotton has been substituted for silk in a shipment of satin whereas the sample upon which the order was taken was all silk.

Abroad paper has been introduced to a considerable degree and it is surprising how fine textured and serviceable some of the cloth is. Burlap substitutes are made entirely of paper yarns or, for other purposes, of kraft paper sheets held by a waterproof adhesive and reinforced with jute or cotton yarns woven between them.

Perhaps most has been done to provide milady with the silk she so admires and with serviceable substitutes where cost is a factor. She is given "heavy" silks with the aid of metallic loading and artificial silk meets many requirements. The artificial silk industry is an accomplishment of this century although the first suggestions were made more than a hundred and fifty years ago. All the silk during the pioneer and development stages was made by the Chardonnet process, although it was not until two companies had failed that the third made such a remarkable success that the stock rose to phenomenal heights. Artificial silk is made from cellulose in the form of wood or cotton. There are several methods, the end products being regenerated cellulose, cellulose nitrate or cellulose acetate. There are many points of difference in the processes employed and yet much that is similar. The purified cellulose is generally brought into solution and this is forced through very small jets or orifices into a bath in which the cellulose compound is insoluble. The jets may be glass or metal, and in order to obtain orifices sufficiently small, very fine wires are sometimes fused into glass and then dissolved out. The thread begins to harden as it enters the bath, forming a semi solid filament which becomes strong, elastic and lustrous after purification, washing, and drying. Where volatile solvents are used, these are recovered, as are the ammonia and copper in the cupro-ammonium process.

The early artificial silks were nitrate products which deteriorated rapidly, were very difficult to dye, and some were quite inflammable. The lustre was much higher than that of natural silk and a common defect was deficient strength when wet. Lack of uniformity in the diameter of the thread persisted for a long time, and there have been many other difficulties but today one may obtain artificial silk of practically any desired lustre, strong even when wet, capable of being dyed any shade, of uniform diameter and great length. In diameter it may be had less than one-thousandth of an inch and up to a sixteenth.

This silk is used in all textile operations, is useful for bristles and artificial horsehair, and in weaving fancy patterns in cloth of other fiber which may then be piece-dyed without affecting the silk.

The artificial silk industry affords an excellent example of the effective methods employed by the German Government to develop German industry. As soon as the patent rights for Germany had been secured by Prince Donnersmarck in 1897, an order was issued to have one of the state apartments of the imperial palace hung with a viscose silk brocade, into which the German eagle was woven as the most prominent part of the design. Nothing else could have done so much at the time to lend encouragement to the industry in Germany nor to popularize viscose silk there.

Silk from tussock moths is now a recognized article of commerce as is also nettle silk.

Concerning silks, it is worth noting that the American silk industry even before the war consumed more raw silk than in any other country and more than France, Switzerland, Italy and Germany combined. More than 108,000 operatives are required.

The frequent discussions on the dye situation will serve to illustrate our dependence upon dyestuffs and it is important to know how various dyes will resist the action of light. Here accelerated tests are necessary for seldom can one wait to make actual sun tests, although fabrics dyed with standard dyes and tested in the sun should be at hand for comparison.

The ultra violet light seems to offer the solution for the problem, the shorter wave lengths producing the same degree of fading in an hour that direct sunlight accomplishes in a day. When we consider the percentage of the time that a garment is in direct sun light it is evident that within a few hours the result of a season's wear may be foretold in most instances. The test is not fully standardized and some dyes do not react toward sun and ultra violet light exactly the same. There is also the possibility that sufficient chemical compounds may be formed in the air through which ultra violet rays pass to exercise some fading action independent of the light. However, the utility of the method is recognized.

It seems fortunate that at the time when there is a necessity for new departures in raiment we know how to provide fiber from new sources as well as substitutes, and that we also know how to determine in advance much regarding wear and service.

Practical Tests

MOST of us work in buildings and live in them, so that interest in building materials may be taken for granted. Ever since our modern introduction to cement and concrete there have been many to theorize as to what happens when a concrete building, with or without reinforcement, is subjected to fire conditions. The questions involved are so important that the Bureau of Standards and the Underwriters Laboratory have undertaken a series of full scale experiments which will show just how columns under stress behave when heated and quenched.

A series of standard columns has been prepared utilizing the different systems of reinforcement and different cement aggregates. A furnace where 2,300 degrees F. may be maintained was built with arrangements for applying pressure to the column under test and for training upon it hose streams while the heat is on. Columns may also be dropped from a height to observe what would happen if a building falls.

Results thus far indicate a difference of over 100 per cent in the resistance of cement aggregates to fire and a variation of from seventeen minutes to eight hours in the time columns will bear the same burden under fire conditions.

The results of this research involving chemistry, metallurgy, and engineering should, when completed, prove reliable guide posts in future building operations.

Dehydration

ALTHOUGH we like to try new things in food we prefer to limit the experiments to new varieties, to unusual products from afar or perhaps to new combinations of well known articles starting with the *materials in their customary condition*. It is very difficult to steer us into a new path even when the necessity is great.

Have you tried dehydrated foods? Not only those that are merely dried but the properly dehydrated ones, for there is a difference. Science has done much on the subject, the idea has been thoroughly proven abroad and yet Americans hesitate to take up this rational, economic innovation. Because of its importance the subject must be emphasized and an educational campaign conducted.

Dehydration makes *fresh* fruit and vegetables available by rehydration whenever wanted. No sugar is used in the process. No glass jars or metal cans are needed; the product may be stored in any box tight enough to exclude dust and insects. There is no loss from freezing, fermentation or rotting, and refrigeration is not required. Most material is reduced 90 per cent in weight and 80 per cent in bulk by dehydration. Seconds, imperfectly formed of poorly colored fruit, small sizes and excess production may be dehydrated and cheaply stored. Dehydrated materials are ready to use—no peeling loss, no labor. There is a saving in transportation. And despite such advantages habit and precedent have been strong enough to hold the majority to the old ways.

New York city is becoming really interested in dehydrated foods and through a special kitchen is introducing such material to her people. Incidentally it is estimated that no less than 1,000,000 pounds of fruit and vegetables will be saved from spoilage each month. The annual capacity of the potato drying plants in Germany is now put at 37,000,000 hundred weight and the plants tabulated as follows:

700 Potato Drying Plants
250 Drying Cylinders
400 Open drying plants
150 Corn drying plants
250 Vegetable drying plants
225 Sugar factories with dryers
22 Milk drying factories
200 Malt kilns equipped for vegetable drying.

Camps, ships and exploring expeditions know the virtues of dehydrated foods but the folks at home seem slow to adopt them. Some community plants have done well in their way and home drying has been done to some extent but the project is one requiring careful scientific control and large scale operation if its products are permanently to compete with the customary "garden truck."

And what of milk and eggs? Milk is about 87.5 per cent water. It is produced most cheaply at such distances from the best markets that it cannot be transported to them. It is difficult to keep and its production throughout the year is not uniform. By proper drying we have a concentrated food that can be kept without ice, is bacteriologically safe and is cheaper than the corresponding grade of fresh milk. For many reasons dry milk is actually superior to fresh milk in the kitchen.

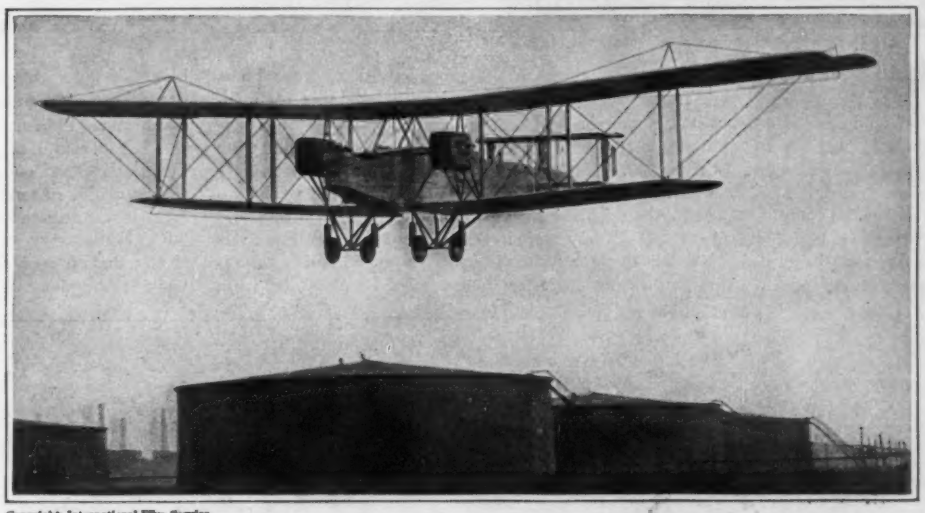
Regarding dried eggs it is interesting to note that American apparatus is being put into operation in China, where eggs are six cents a dozen and not six cents each as with us, to help supply our needs. It takes 51 yolks to make a pound and one plant has a capacity of 2,000 pounds in 10 hours. Fresh eggs dried in China and sent here will make a far safer and better omelet than many of our cold storage eggs. Years ago experiments with eggs dried in the same way by the American originator of the plan were very successful and the value of the properly prepared egg powder established.

America was introduced to canned foods by the Civil War. Perhaps the present conditions may teach us to value dehydrated foods. The bakeries, hotels, etc., already appreciate the advantages. It does seem to take us a long while to profit from the experience of others and apply their ideas to our needs.

Our First Handley-Page Plane—The "Langley"

NO longer is there cause to doubt our ability as aircraft producers. For with the successful test flights of our first Handley-Page bombing plane at Elizabeth, N. J., on July 6th last, we have proved our competency to construct aircraft suitable for battle service.

Our first Handley-Page, constructed from British plans by American men and women, has been appropriately named the "Langley," in honor of Dr. Samuel P. Langley who led the way in heavier-than-air flight by his numerous experiments before the days of the airplane. Built entirely of American materials, including the twin Liberty engines, the "Langley" is truly an American craft in all but design which, dictated by the best of practices, we have adopted from our ally because such procedure ensures immediate success.



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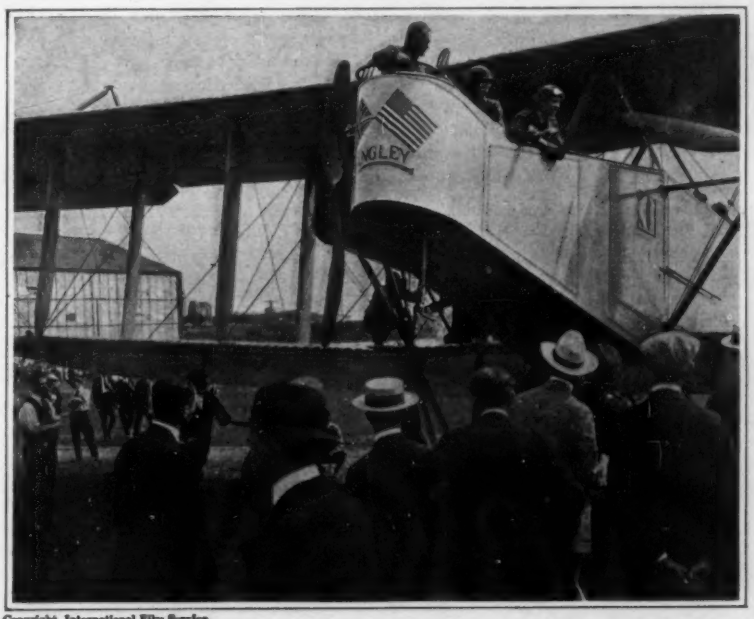
American-built Handley-Page bombing plane, the "Langley", in flight. This huge plane is equipped with two Liberty motors

The "Langley" is of the regular Handley-Page type which is being extensively employed on the Western Front for bombing operations. It is a huge machine among airplanes, measuring about 100 feet in wing span, 63 feet for the fuselage, and weighing some 9,000 pounds with the cargo of bombs. It can carry in comfort 20 passengers, and although designed primarily as a weight carrier, the "Langley" can do somewhat better than 100 miles an hour when tuned up. The two Liberty engines, which are enclosed in armored nacelles on either side of the central fuselage, are rated at 400 horsepower each, and are said to consume fuel at the rate of 60 gallons per hour for the pair. Even if one of the propellers or one of the engines should become disabled for any reason, the machine could still keep to the air, although with its speed materially reduced, on the remaining propeller and engine.

The armament of the "Langley," apart from its cargo of bombs destined for German military and industrial establishments far in the land of the Hun, consists of two Browning machine guns, which, by means of the well-known revolving cradle arrangement, can be aimed in almost any direction at the front and at the rear.

It is to be hoped that the "Langley" will be followed by fleets of similar machines of that type and other types found successful in actual aerial warfare. For since the beginning of the present year aerial bombardment has been extensively carried on by both sides; and more and more it is becoming evident to all that aerial bombardment is a vital military force. So it is that every bombardment plane which we send across to France, every bomb which we manufacture for the use of such planes, and every hit which our airmen score on important Hun targets, whether they be railroad junctions, ammunition dumps, chemical works, arsenals, or even cities when it comes to a question of reprisals, bring the war that much closer to a victorious ending for the forces of Democracy.



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The bow of the "Langley", showing cradle mounting for forward machine gun and giving some idea of the roominess of such a craft

A Photographic Working Model of the Gnome Aviation Engine

THERE is no better way of exhibiting the operation of any given machine or process than by the use of a working model. Lectures, text books, photographs (except motion pictures)—all these methods are excellent as supplementary instruction or as a substitute for the working model when the latter is unavailable; but it is a well-known fact that a working model will give students a better grasp of the subject in the least amount of time and with the least effort on their part and on the instructor's part.

So when it came to teaching the principles of the Gnome monosoupape aviation engine to the students at the West Side Y. M. C. A. Airplane Mechanics School of New York city, the faculty decided upon using the real thing. The school has several Gnome engines which can be dismantled and reassembled and operated, and at least one engine which is partly cut away to exhibit some of the working parts. Still, even the latter was found unsatisfactory in depicting the action of what is perhaps the most remarkable of airplane power plants. Furthermore, something had to be done to speed up the work; for the course is very intensive and but little time can be devoted to any one type of engine.

At this juncture it was decided to construct a sectionalized working model of the Gnome monosoupape engine, and the work was planned and supervised by the principal of the school, Mr. Frank F. Tenney, and Mr. Adrian Van Muffling, Chief Engine Instructor. The completed model, when presented to a class for trial, met with such marked success that its educational value was at once established. Then and there it was decided to improve on the original model, which, being hand-made throughout, was necessarily crude.

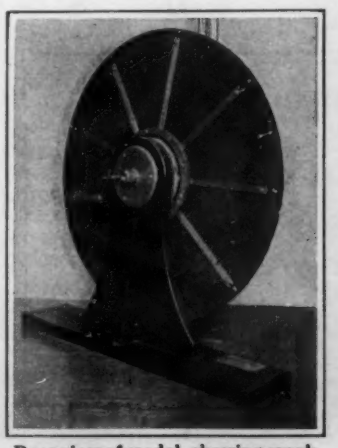
The camera was enlisted in the ranks of the model makers. Actual photographs of Gnome monosoupape parts were employed, with the result that the completed device clearly shows all parts of the engine in their proper relationship to each other. Indeed, it will be noted from the accompanying illustrations that the engine is quite realistic in appearance, due to the use of actual photographs throughout.

The model consists of a revolving wooden disk mounted upon a suitable stand. Nine sectors cut accurately to size are attached to the face of the dial. The edges of these sectors form guides for the moving pistons. A lynite hub and flange form the bearing for this disk, which runs upon an accurately machined crankshaft. The pistons are lynite, while the master connecting-rod and the little connecting-rods are brass bars. The crank case, pistons, master connecting-rod, little connecting-rods, crank throw, crankshaft (short end), and cylinder walls are covered with actual photographs of the individual Gnome monosoupape parts. The valve cages, fins, spark plugs, etc., are printed from an accurate mechanical drawing of the engine. It will be seen that the result is an exact reproduction of the Gnome engine as it would appear if cut along its transverse axial plane.

The nine valves are operated by means of a concealed cast lynite box cam, which is mounted behind the disk and attached to the stationary stand. The camr iders are specially-designed lynite castings and transmit their action through adjustable brass rods to the valves situated in the cylinder heads. The entire mechanism is brought into action by the operation of a handcrank, which turns the disk through a concealed planetary gear with a ratio of 5 to 1. It will be noted that the dimensions of the valve-head are purposely exaggerated so that its action may be clearly observed and that it will lend itself to instructional purposes. The valves are made from lynite castings, an extension being cast in the rear of the stems which guide them in the disk.

The cycles of operation may be clearly followed in all cylinders, the exhaust opening 85 degrees past top dead center, valve continuing to remain open for 395 degrees. It then closes 60 degrees before bottom dead center, and remains closed for the completion of the cycle. At 20 degrees before bottom dead center the pistons uncover the gas inlet ports, which remain open for 40 degrees. The firing order for this engine is 1, 3, 5, 7, 9, 2, 4, 6, 8.

The entire model can be disassembled, the same procedure being followed as in the actual Gnome monosoupape engine itself. This model, however, is not intended for instruction on this class of work, actual engines being employed for that purpose.



Rear view of model, showing crank, gear case and valve arms

Making use of photographs of actual engine parts, this realistic Gnome model is ideal for instruction purposes

Cheaper Radium

AS the result of an agreement between the National Radium Institute and the Bureau of Mines, Department of the Interior, to develop a more efficient process for the manufacture of radium from carnotite ores of Colorado and Utah, the Bureau now has as its share more than $180,000 worth of radium for use in the sciences. This was procured for an expenditure of less than $38,000. In addition, under the agreement, the Bureau of Mines has turned over to the National Radium Institute about 6½ grams of radium, and has given to the country a method for producing pure radium compound from the ore for as little as one-third the current price of radium.

When the Bureau of Mines began this work in 1912, it found that the precious carnotite ore, constituting the largest known supply of radium ore in the world, was going to Europe, mainly to Germany, where it was being turned into radium and sold back to the United States at fabulous prices.

The Motor-Driven Commercial Vehicle

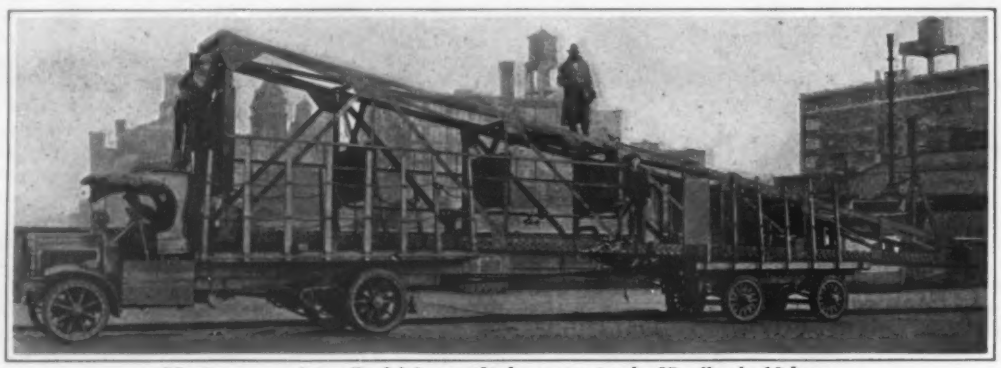
Conducted by VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Relying on Trucks When Freight Cars Fail

FLEETS of motor trucks in service along the Atlantic seaboard have offered timely relief to many large manufacturing companies who found it impossible to secure materials or make their regular deliveries owing to the shortage of freight cars and the general terminal congestion caused by the submarine menace. In Philadelphia a good share of this business has been handled by a hauling contractor, who owns a fleet of 66 large trucks and is prepared to contract for hauls of any length.

An interesting example of how emergencies of this kind have been met is the recent hauling of several large copper chemical stills for a large chemical company of Maywood, N. J. The stills, which were 8 feet high, 7 feet in diameter and weighed nearly 5,000 pounds were built in Philadelphia. Owing to the steadily advancing price in chemicals the company ordered work on their construction rushed, but when they were ready for delivery no freight cars could be secured in which to ship them. Two of these huge tanks were loaded on one of the Philadelphia contractor's trucks and hauled to the chemical plant in less than 12 hours.



Moving a complete pile driving outfit, by motor truck, 25 miles in 18 hours

About the same time a call was received from a chemical company of Camden, N. J. This concern had a large shipment of picric acid which they wished delivered to a customer in Easton, Pa., sixty miles away. Because this acid is an ingredient in a high explosive, the railroads refused to carry it and the freight cars for shipment were not available even had they been willing to accept it for transit. The Philadelphia hauling contractor accepted the contract and a fleet of his trucks hauled the acid to Easton in 10 hours without experiencing a mishap of any kind.

At Marcus Hook, Pa., well known rug manufacturers, evaded the railroad tie-up by contracting for the use of trucks to haul long and heavy rolls of felt paper from Philadelphia to the factory, a distance of approximately 30 miles. The company was so well pleased with the work of the trucks that they have entered into a contract for hauling this paper by motor truck for a period of a year. In railroad shipments the ends of the paper rolls were frequently damaged, but the trucks deliver them in perfect condition. One truck hauls about 2,000 tons of paper a month, averaging two round trips between Philadelphia and the mill in 10 hours' time.

A short time ago a tapestry company located at North Wales, Pa., purchased a new factory in Frankfort, Pa., 60 miles away. The problem of moving the large stock of costly machinery was a serious one because North Wales offered no direct railroad communication and the plant was located several miles away from the nearest station. The cost of packing was another large item of expense and railroad officials were unable to guarantee a definite date when flat cars would be furnished for carrying the machinery. The motor truck railroad moved all of the machinery and other furnishings of the plant in a single day and it all arrived at the Frankfort factory in perfect condition, despite the fact that it was merely covered with sheets of heavy canvas. Officials of the company declared that this speed in moving saved them thousands of dollars.

Another striking example of how the railroad blockade was broken with trucks is the transportation of a stock of $80,000 worth of imported Turkish rugs from Philadelphia to New York. The rugs were loaded into an open truck and taken to a Broadway shop a distance of 96 miles in less than 10 hours.

The charge for this service was 75 cents per hundred pounds. The rugs, which were owned by prominent rug importers, had been taken to Philadelphia for exhibition purposes. When the exhibition closed the merchants desired to send them back to New York as soon as possible. The truck route was decided upon after the railroad officials had declared themselves unable to accept the rugs for shipment. The importers said that every day the rugs were in the warehouse meant hundreds of dollars to them in lost sales. The speed and dependability with which the valuable rugs were hauled from Philadelphia to New York attracted widespread attention among the business men in both cities and a few days later a representative of a foreign government offered the Philadelphian a contract to haul 15 tons of stockings from a Philadelphia stocking factory to the ocean piers in Manhattan. The steamer was scheduled to sail the next day at noon. The stockings were loaded on three trucks at 5 o'clock in the evening and unloaded on the dock in New York early the following morning.

The war abroad and the preparedness plans of the United States Government brought large contracts for munitions to a large powder company and caused the town of Penn's Grove, Pa., where the plant is located, to triple its population almost over night. The newcomers came so fast that the town butcher was unable to keep them supplied with meat. Finally a committee was appointed to search for a new butcher and to induce him to move to Penn's Grove.

Delivering large copper stills by motor truck where no cars were available

Such a man was found in South Philadelphia, 45 miles from the mills, but then came the problem of moving his large stock of meats, chopping blocks, saws, refrigerator bins, chopping machines, office equipment and other furnishings. Shipments by freight were almost at a standstill. The following evening a fleet of trucks moved the butcher and all his belongings. He was open for business in Penn's Grove the following morning.

The utility of trucks in extraordinary work was strikingly demonstrated in Philadelphia a short time ago. The Emergency Fleet Corporation commandeered the plant of a large shipbuilding company "somewhere along the Atlantic Coast."

Proposed extensions to the plant for the purpose of increasing the production included new shipways which had to be supported on large concrete piles. A Concrete Pile Company was awarded the contract for driving the piles, on condition that they begin work within two days. The company's nearest pile driving equipment was in the League Island Navy Yard, 25 miles away. Railroad facilities were not available. The Philadelphia hauling contractor moved the entire outfit consisting of the pile driving tower, turn-table and bed sills, giant boilers, engines and additional equipment in 18 hours at a great saving of time and money.

Novel French Agricultural Tractor

THE war has greatly stimulated the development, manufacture and use of agricultural tractors abroad because the lack of men and animals formerly engaged in food production has made it imperative to use machinery to raise the required quantity of food stuffs. The scarcity of labor has been met to some extent by the use of thousands of tractors, most of which are American made. One of these was recently described in these columns.

A tractor designed to meet conditions prevailing in the French vineyards as well as in general agricultural work is illustrated herewith and was described in a recent issue of *Automotive Industries*. This machine is the invention of an automobile engineer and naturally it incorporates numerous automobile engineering ideas in its make up. The American tractor makers do not make their machines narrow enough to work in French vineyards, where the grapevines are planted about a meter apart or about 39 inches. This machine is very narrow, its width being but one inch greater than three feet, this allows it to go between the vines without difficulty. The machine is of the light-weight type, to reduce fuel consumption, and the engine is of moderate power for the same reason.

The engine is of two bearing crankshaft, four-cylinder type, with the cylinders cast "en bloc." It delivers about six horse-power at the drawbar, which is sufficient tractive power to pull a two furrow plow set to cut furrows six inches deep. The machine is said to be able to plow about four acres of heavy ground or six acres of light soil in a ten-hour day. The engine has a bore of 62 mm. and a piston stroke of 145 mm., roughly 2½ by 5¾ inches. It is said to develop 10 horse-power at 1,000 turns of the crankshaft per minute. It has force-feed oiling and high tension magneto ignition and it is cooled by the natural or thermo-syphon system with the radiator placed back of the engine. The radiator is carried high enough to secure a good head of water and the water spaces and pipes are exceptionally large. A fan is carried in front of the radiator, being driven by belt connection with a large V-grooved pulley machined in the large hub of the flywheel.

The power transmission is a unique feature of this

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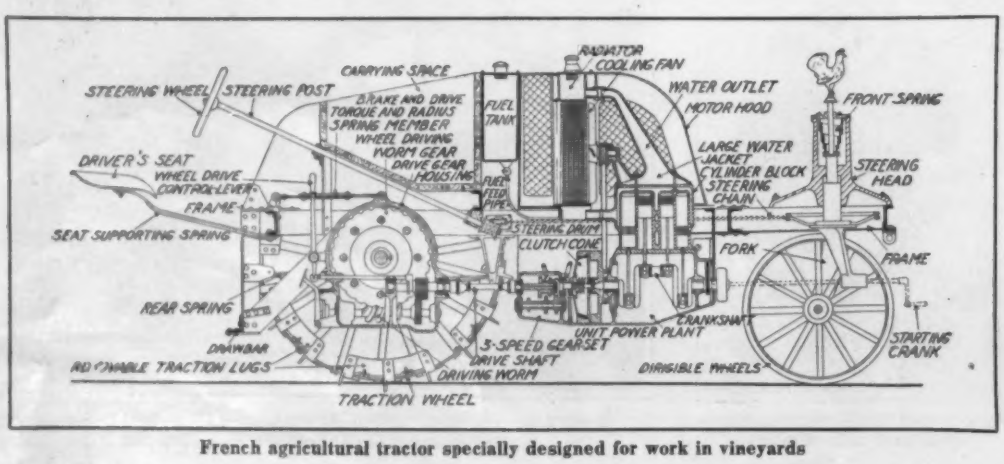


French agricultural tractor specially designed for work in vineyards

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

CONVERTIBLE GARMENT.—ELLEN M. H. WEBB, care of Hutchinson, 145 W. 98th St., New York, N. Y. The object of the invention is to provide a convertible garment combining a dress and overalls more especially designed for use by children, and arranged to permit of conveniently and quickly converting the dress into overalls or vica versa, thus allowing a child to walk to and from a playground fully and cleanly dressed, to permit the child to play while in the overalls, the dress portion being protected from being soiled.

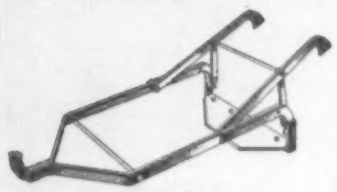
SEAM FOR RAIN COATS.—R. R. SANDFORD, New London, Ohio. The object of the invention is to provide a seam for rain coats and other similar waterproof garments, with arrangements to prevent the seam from accidentally opening and to render it waterproof. In order to accomplish the result, use is made of a strip of fabric overlying the overlapping seam sides of the garment, an adhesive substance between the contacting surfaces of the seam sides and the strip, and stitches connecting the sides of the strip with the seam sides the adhesive substance filling the stitch holes.

Pertaining to Aviation

AUTOMATIC IGNITION CUT OUT SWITCH FOR AEROPLANES.—J. S. BENNETT, care of Curtis Engineering Corp., Garden City, L. I., N. Y. The invention relates to a cut-out switch for the ignition system of an aeroplane, whereby the ignition circuit will be opened to prevent the danger of an explosion of the gasolene when the machine falls and strikes the ground or to immediately stop ignition, when necessary, the switch includes a movable element normally under spring tension and held in open-circuit position by means connected with the frame of the aeroplane and so related to the engine that when the latter is displaced the means will shift relatively and permit the switch to ground the ignition circuit.

Of Interest to Farmers

HARVESTING PLOW.—J. E. METHVIN, 224 Barbour St., Eufaula, Ala. The invention relates generally to plows, but more particularly to a plow for harvesting peanuts, the object being to provide a simple and quickly adjustable plow for this purpose, in the utilization of which, in connection



PERSPECTIVE VIEW OF THE PLOW

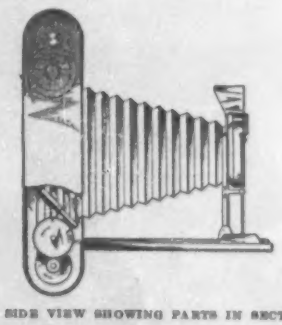
with certain characters of peanuts, the roots will be clipped or cut off, and parts thereof left in the ground in order to supply nitrogen thereto, the machine also be used for preparing the soil for crops, and effectively breaking up the ground without formation of furrows.

TRACTOR.—A. M. DAVIS, Mesa, Ariz. An object of the invention is the provision of a structure which will operate for moving in either direction, while allowing the master propelling member to move continuously in the same direction. Another object in view is to provide a tractor in which earth engaging members are provided and connected up with a primemover so as to push or pull a load.

Of General Interest

SCOOP.—D. O. TAYLOR, West Point, Miss. This scoop is of the character designed for grocers use, wherein a scoop and a handle are provided, and weighing mechanism in connection with the handle and operated by the downward movement of the scoop under the influence of the weight in the scoop, means being provided for locking the handle to the scoop in a manner to prevent the entrance of pulverulent matter during the insertion of the scoop into such matter.

CAMERA.—J. L. JOHNSON, 313-316 Liberty Bldg., Seattle, Wash. The invention has for its object the provision of a camera of the repeating type, wherein the film winding means is spring operated and normally restrained from action,

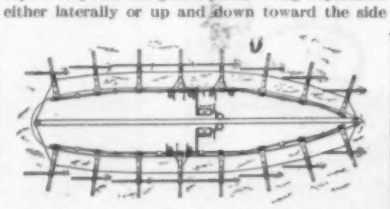


A SIDE VIEW SHOWING PARTS IN SECTION

and released by the snap of the shutter to present a new skutch of film after each exposure, and wherein means is provided for checking the action of the film winding means, when a predetermined length of film is in exposing position.

MEANS FOR SEALING STORAGE TANKS.—G. W. MERRILL, Tulsa, Okla. An object of the invention is to provide a storage tank for volatile oils having means for sealing the joints between the body portion of the tank and the roof, so as to prevent the escape of the gas, at the same time to provide means for conducting charges of electricity from the roof to the sides of the tank or vica versa, the sealing means being applicable to metal tanks of existing types.

TORPEDO-GUARD.—B. G. WILLIS, Avoca, N. C. An object of the invention is to provide a torpedo guard including a plurality of guard plates spaced from the side of the vessel to intercept a torpedo, the guard plates being adjustable either laterally or up and down toward the side



A PLAN VIEW SHOWING OPERATING MECHANISM OF THE PLATES

of the vessel to cover a breach made in the continuous line of guard by the destruction of one of the plates upon the explosion of an intercepted torpedo, the plates being pivotally mounted on vertically adjustable booms.

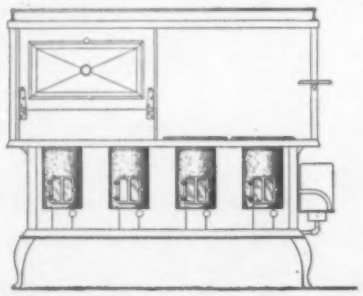
MARINE VESSEL.—E. C. BAECK, 130 N. Broadway, Irvington-on-Hudson, N. Y. The object of the invention is to provide a marine vessel more especially designed for the transportation of large amounts of supplies or freight for supplying vessels at sea or to be carried to distant ports. Other objects are to provide a base for aeroplanes, submarines or other small air or marine craft, and to permit the use of the marine vessel as a floating dry dock.

TOILET OUTFIT.—A. F. WALTZ, 503 W. 149th St., New York, N. Y. The object of the invention is to provide a toilet outfit including a pair of military brushes arranged to permit their use for brushing the hair in the usual manner and to form a convenient housing for toilet accessories or toilet article such as a toothbrush, powder box, safety razor and the like. In order to accomplish this result use is made of brush having a hollow back provided in its side wall with an opening, a drawer adapted to fit into the hollow back for holding the articles.

PENCIL ERASER ATTACHMENT.—E. G. BALCH, 103 State St., Newburyport, Mass. The purpose of the invention is to provide an attachment adapted to be applied to any ordinary pencil and comprises two main rigid parts, one movable relatively over the other and in connection with which is employed an eraser held by the relatively movable part so that a comparatively short length of the eraser is exposed for use, but which when worn down is adapted to be again exposed by movement of the movable member.

Heating and Lighting

OIL STOVE ATTACHMENT.—J. T. KELLY, West Rush, N. Y. The prime object of the invention is to provide a jacket of non-heat-conducting material to be applied to the chimney of an oil stove, whereby to prevent any material



FRONT VIEW OF AN OIL STOVE, BURNERS BEING EQUIPPED WITH THE DEVICE

radiation of the heat from the chimney into the room, and arranged to be supported on the top of the chimney in a manner to dispose the top of the jacket above the chimney. A further object is to supply a heat deflector that will permit a portion of the heat to pass directly through the grid at the center, while deflecting a portion of the heat laterally.

Machines and Mechanical Devices

TRANSMISSION MECHANISM.—R. D. GEORGE, 4341 Tracy Ave., Kansas City, Mo. The invention has for its object to provide a mechanism, wherein a driven shaft is provided consisting of sections, to each of which a disk is connected, the sections being connected by reversing mechanism so that they may rotate in the same direction, together with a connecting wheel movable radially of the disks for connecting the same to vary the relative speed of the driven shaft.

Medical Devices

ARM SUPPORT.—J. A. STOWERS and J. BAZANT, Gouverneur Hospital, New York, N. Y. The invention relates to surgical appliances, its object is to provide an arm support or sling arranged to support a broken or otherwise injured arm with the utmost comfort, and to allow of conveniently placing the arm in position on the support or removing it. To accomplish this result, use is made of a neckband attached to an open hook, adapted to receive a trough-like rest to receive and support the forearm.

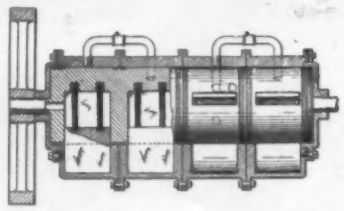
Musical Devices

JEWS' HARP.—E. O. COOK, 36 Atwells Ave., Providence, R. I. The invention relates to an instrument generally known as a jews' harp in which a vibrating tongue is secured at one end in a frame of a form to present a loop. An object is to provide a jews' harp in which the arms of the frame will be held rigid so that when the side arms are placed against the teeth of the operator they cannot be accidentally brought together to interfere with the vibrating tongue.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—H. D. GIRVAN, 2326 9th Ave., Beaver Falls, Pa. The general object of the invention is to provide an engine provided with valve mechanism having the simplicity of the puppet valve with the efficiency of the sleeve valve, and wherein the valve cannot get out of time, is not effected by carbon and needs no grinding.

ROTARY ENGINE.—W. ZABRISKIE, Pagosa Junction, Colo. The object of the invention is to provide a rotary internal combustion engine which has two cylinders, one used to compress the combustible mixture which is ignited in the other. The expanding gases act against pistons to rotate



A SECTIONAL VIEW OF THE ENGINE

a shaft, there being a by-pass in a rotable member disposed in the compressing cylinder which carries the pistons acting in the cylinder, to permit the passage of the compressed combustible mixture, this combustible mixture passing through a communicating means to the motor cylinder.

PISTON FOR INTERNAL-COMBUSTION ENGINE.—J. T. BENTHALL, Suffolk, Va. An object of the invention is to provide a piston whereby an increase of power is obtained. The construction provides a piston having a head, the greater portion of which is a plain flat surface, with outwardly curved edges, the curved portions being relatively near to the sides of the piston, by this form of construction, the force of the explosion along the side walls is deflected away from the point of escape around the piston head and focused directly upon the piston head.

Railways and Their Accessories

VESTIBULE CURTAIN COUPLING.—M. J. ROCHE, 13 Manheim St., Elmhurst, L. I., N. Y. The invention relates particularly to a construction for coupling the curtains used on vestibules of railway coaches, the main object is to provide a structure which holds the curtain in proper position but will automatically become disengaged. A further object is to provide a coupler having a head or knob with pivotally mounted jaws engaging the same, and a sleeve holding the jaws in position until the cars have separated and pulled the head to a position outside the sleeve.

LOCOMOTIVE TENDER COAL PIT.—E. G. BARTLETT, address P. Dandelin, 81 Pennsylvania Ave., East Somerville, Mass. The invention deals particularly with the construction of a coal pit, whereby the automatic feed of the coal by gravity is positively insured. The special aims of the invention are to supply the coal to the fireman constantly and keep the whole mass of coal in motion so that it will not pack down solid without the use of any mechanism, being an integral part of the tender, the upkeep after installment costing no more than the common coal pit.

AUTOMATIC TRAIN-STOP.—M. B. BULLA, 216 Martin Bldg., El Paso, Texas. An object of the invention is to provide automatic train control mechanism including a normally closed circuit, the breaking or disarrangement of any part of which will insure the stopping of the train. A further object is to provide means whereby, even though the automatic stopping mechanism is controlled by the normally closed circuit, yet the engine driver is enabled to pass a danger point if required to do so under orders without initiating the action of the automatic stopping mechanism.

PISTON PACKING RING.—E. R. BALES, 206 North Hickory St., Centralia Ill. The invention relates to packing rings adapted to be employed more particularly on the pistons of locomotive power reversing gears, air brake triple-valve pistons, and other devices in which the movement of the piston must be controlled by very small difference of pressure on the respective sides thereof. This object is attained by employing a pair of packing rings representing opposite leveled surfaces at their inner corners and an expanging ring exerting a wedging action on the packing rings at the surfaces to force the packing rings obliquely outward.

Pertaining to Recreation

GAME APPARATUS.—E. HECKMANN, Box 91, Hermann, Mo. The object of the invention is to provide a game having a board with a gate at one end, there being two sets of openings in the board beyond the gate, one set at each side of the board, the openings at one side of the board indicating offensive plays with a penalty if the player does not succeed in making the play attempted, and at the other side defensive plays with a penalty if the player does not make the attempted play.

Pertaining to Vehicles

VEHICLE WHEEL.—J. F. KEMP, Manila, Philippine Islands. The invention relates generally to vehicle wheels, but more particularly to a construction thereof embodying relatively movable parts whereby to bring about resilient support of a vehicle, and between which parts an inflatable tube is interposed, of greatly reduced cross section and circumference with respect to the usual inflatable tube at the tread of a wheel, thus saving materials, eliminating all punctures, and reducing the cost of upkeep.

THERMOSTATIC FAN.—R. N. COATS, 306 First Ave., So. Seattle, Wash. The object of the invention is to provide thermostatic fan more especially designed for use on automobiles and similar vehicles for controlling the air circulated through the radiator to maintain the water in the radiator at a desired temperature. In order to accomplish the result use is made of a fan wheel and thermostatically controlled means mounted on the fan for turning the latter according to the temperature of the surrounding atmosphere.

MOTOR CYCLE ATTACHMENT.—G. E. FRETZ, 423 S. High St., Pratt, Kans. The invention relates to a motor cycle controlling clutch. The object is to provide controlling means associated with the clutch lever and its actuating lever and arranged to counterbalance the increasing spring pressure exerted by the clutch spring when the clutch is moved away from the engaged position, so that the clutch will be maintained in any given position including that of partial engagement.

REAR END SIGNAL FOR VEHICLES.—G. RUSIAS, care of M. E. Canle & Co., 79 Wall St., New York, N. Y. Among the principal objects which this invention has in view are to provide a simple means for indicating a warning in traffic, to imploy a single device for indicating various intentions, to provide a structure difficult to damage, and provide means for operating the signal in correspondence with the operation of the automobile with which the signal is associated.

DIRIGIBLE HEADLIGHT CONNECTION.—H. D. HARVEY, Hillsdale, N. Y. The invention has particular reference to means for swinging headlights laterally coincidentally with the turning of the vehicle. Among the objects is to provide means whereby the headlights of an automobile are adapted to be so connected to the steering devices of the front wheels as to be turned automatically in connection with the steering of the vehicle, but with provision made so that the lamps may be left stationary with respect to the body if desired.

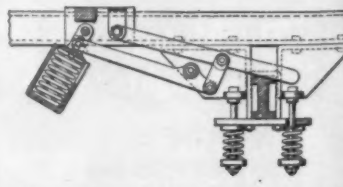
RESILIENT VEHICLE TIRE.—DR. I. N. KEIM, Mount Holley, N. J. The object of the invention is to provide a resilient tire having a body made of rubber or similar resilient material subjected to flexion and extension and eliminating

A CROSS SECTION OF THE TIRE

direct compression. In order to accomplish the result, use is made of a hollow rubber annulus adapted to be fastened to the felly of the wheel, a floating metal rim attached to the peripheral face of the resilient body, and a rubber treat attached to the floating metal rim.

CLUTCH.—M. C. DART, care of Kremser, 326 E. 155th St., New York, N. Y. Among the principal objects of this invention are, to avoid shocks when coupling power mechanism with transmission mechanism, to automatically release the transmission mechanism from adjacent parts of the driving mechanism under certain prearranged conditions, to provide a simple slipping clutch, and to provide means for compensating for the disalinement of transmission and driving elements when operatively connected by the clutch.

VEHICLE SPRING SUSPENSION.—J. TREANOR, 310 W. 121st St., New York, N. Y. The invention relates to automobiles and other vehicles. Its object is to provide a spring suspension arranged to minimize jolts and jars incident to the vehicle traveling over rough roadways



A SECTIONAL SIDE ELEVATION OF THE SPRING AS APPLIED

thus insuring easy riding. Another object is to permit the use of comparatively light springs. In order to accomplish the result use is made of connected levers fulcrumed on the vehicle body, one of the levers being connected with the axle, and a spring supported on the vehicle body and engaged by another of the said levers.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

TORBENSEN INTERNAL GEAR TRUCK DRIVE

Which Rear Axle—*and Why?*

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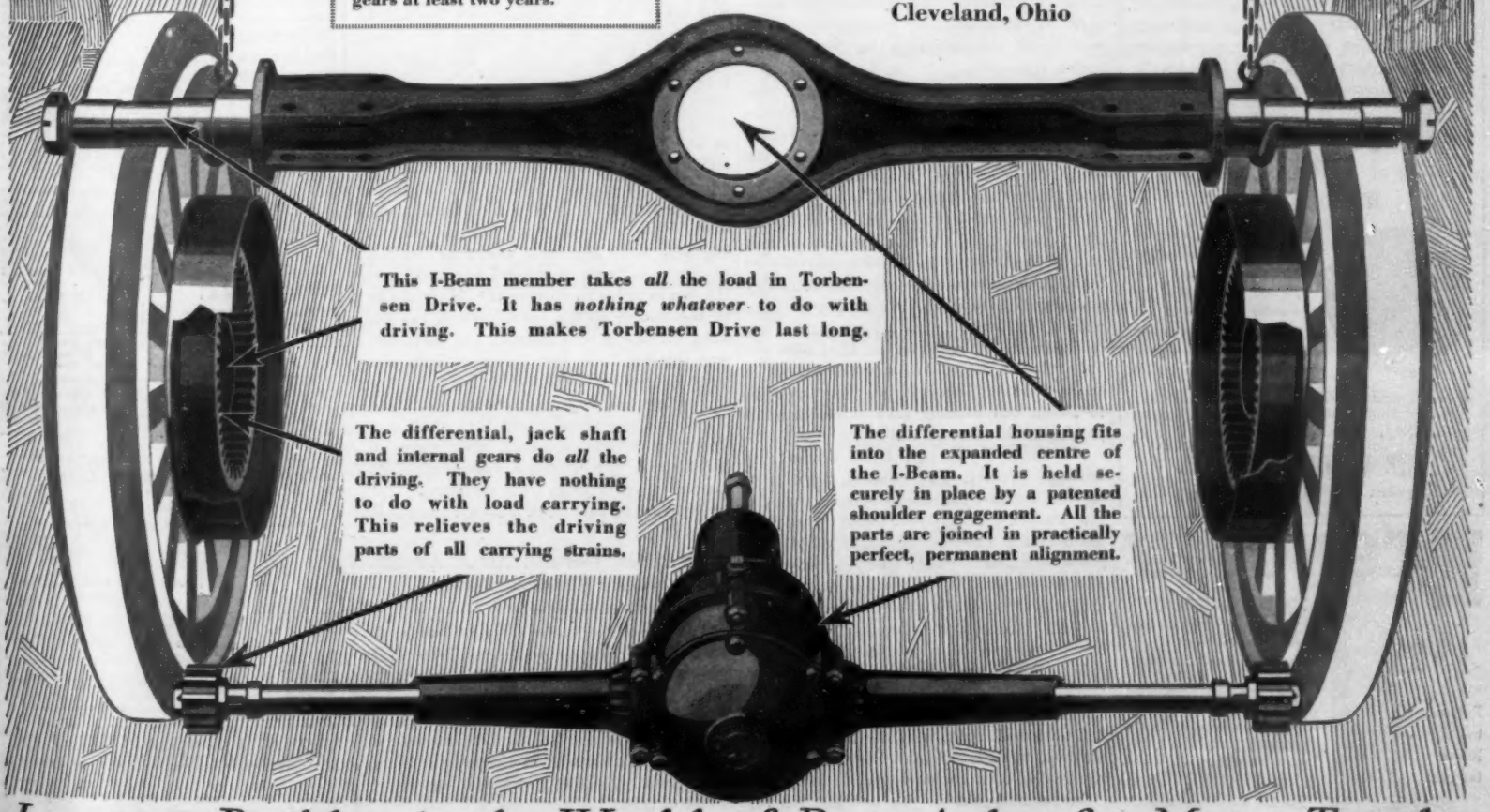

Largest Builder in the World of Rear Axles for Motor Trucks

The Salvage of Deeply Sunken Ships

(Concluded from page 43)

action by spacing them along on each side of a wreck.

The pontoons can be adjusted vertically for a movement of thirty feet. That is to say, when a vessel is carried by them into water having a maximum depth of thirty feet their field of service ceases and other salvage practices must be employed. Their primary purpose is to deal with deeply submerged ships; to raise them successively in thirty foot stages while moving into shallower depths; and, finally, to ground the craft in protected waters where the wreckers can complete their job without the hazards and difficulties incident to work in the open sea. The vertical movement of the pontoons when shortening up the slings for another lift is effected by weighting the cylinders with water ballast or by taking advantage of the falling tide—the ship in the meantime resting upon the seabed. Pontoons of this nature have another advantage over those that are entirely submerged, because they are always visible and can therefore, be controlled from the surface with a fuller instant grasp of the problem as a whole.

Divers need be employed but sparingly. All that would be required of them is to help locate the exact place and posture of the wreck and to direct the adjustment of the slings as they are brought under the bow or the stern of the vessel and worked, by the aid of the excavating air blast, into the required positions. The cylinders are substantially self-contained salvage units, and only towing vessels and a moderate floating plant would be needed to raise a ship.

The Teleferica

(Concluded from page 46)

and length of the lift—is always installed at the upper station. The usual provision is for two baskets, one coming up while the other goes down. As with the ore-tramways, however, an installation can be made—if sufficient power is available—to carry two baskets or three, or even a greater number of baskets.

The two greatest enemies of the teleferica are the avalanche and the wind—the latter because it may blow the baskets off the cable and the former because it may carry the whole thing away. As the tracks of snow-slides—the points at which they are most likely to occur—are fairly well-defined, it is usually possible to make a wide span across the danger-zone with the cable and thus minimize the chance of disaster on this score. It is only when the dread "Valanca"—as occasionally happens—is launched at some unexpected point that damage may be done to an aerial tramway.

Though the number of disasters of this kind from avalanches may be counted upon one's fingers, trouble from high wind is always an imminent possibility. In the early days of the teleferica accidents traceable to the blowing off of the baskets were fairly common; in fact, it was feared for a time that the difficulty from this source might be so great as materially to limit the usefulness of the cableway system. The use of more deeply-grooved wheels, however, did away with this trouble almost entirely, so that now the only menace from the wind is when it comes from "abeam" and blows hard enough to swing the baskets into collision when passing each other in mid-air.

All sorts of freight, from ducks and donkeys to shells and cannon, have been carried by the teleferica, and one of the best stories told on the Italian Front had to do with a pig—the mascot of a Dolomite glacier—which found its way up there by means of the cable. He was a sucking-pig, and was sent up alive to be reared for the major's Christmas dinner, when the teleferica basket in which he was traveling got stuck in a drift which had encroached upon one of the steel towers. Twelve hours elapsed before it was shoveled free, and the sucking pig, when it finally reached the top, was frozen hard and stiff as one of his cold-storage brothers. It was only after he had lain in the hot kitchen for several hours that an indignant grunt revealed the astonishing fact that his armor of fat had kept smouldering a spark of life. They reared him on a bottle, and today he is a porker of 200 pounds or more, drawing a regular ration of his own.

The other winter a teleferica was destroyed by an avalanche, leaving a band of Alpini marooned on the side of a glacier with only a few days' supply of food and ammunition. The story has been told in these columns in connection with a cover drawing which depicted the incident, but perhaps it will bear repeating. The difficulty was to reach these men. To have repaired the teleferica would have been the work of several weeks, and the only path leading to their eerie was scoured away by the slide. No doubt the mountaineering genius of the Alpini would have been equal to the problem of finding their way back to safety by letting each other down by ropes, but this would have involved the abandonment of a position which it was vitally important to hold.

The somewhat daring expedient of shooting a cable up from a gun was accordingly resorted to as a quick means of succoring the marooned men. A shell attached to a light cable went wide, and all attempts with high-velocity guns were failures. It was not until one of the new long-range trench-mortars was brought up that the experiment took an encouraging turn, though success was not won until the cable's line was displaced by a light manila rope. This was fired to its goal—an eminence half a mile distant and 1,000 feet high—at the first shot, and afterwards served to drag up a light cable which in turn dragged up the heavy one. In this way communication was quickly restored.

Perhaps the most spectacular exploit ever carried out from a teleferica was that by which a troublesome nest of Austrian machine-gunners was cleared off one of the pinnacles of the great M——— *massif* in the fall of 1916. At that time the lofty ridge was divided between the Italians and Austrians. The latter had access to one splintered pinnacle which, although there was no room to establish a permanent position there, offered a splendid vantage from which to observe all Italian movements in the valley beneath. The situation was irritating enough for the Italians even when the activities of the enemy were confined only to observation, but when he took to bringing a machine-gun up and peppering—almost from its rear—the headquarters of an Alpini battalion which held an important pass 3,000 feet below, it became well nigh intolerable.

Then one of the engineers discovered that there was a point between the third and fourth towers of a nearby teleferica from which the Austrian machine-gun position could be enfiladed with deadly effect. Accordingly the platform of a machine-gun was hung on to the cable at an angle which would make it easy to elevate and range on the Austrian position above. The exposed side of the platform was protected by a sheet of bulletproof steel. When all was ready a gunner and an engineer took up their positions on the platform and over all a black tarpaulin was thrown in order to deceive the Austrians as to the nature of the load. When the desired elevation was gained, the tarpaulin was thrown back and a rain of lead was poured upon the troublesome gun. It was so unexpected, coming from the air, that before the Austrians could turn their gun upon the aerial attackers, they were all killed, and the Italians experienced no further trouble from this quarter. Our cover drawing this week is based upon this incident.

Fifty Billion German Allies Already in the American Field

(Concluded from page 47)

worms are found to be abundant on corn land, but proper rotation of crops is the best preventative measure. Pasturing hogs upon land supposed to harbor cutworms is a beneficial practice, as these animals root up and devour insects of many kinds, including cutworms, in large numbers. Farm poultry, allowed to follow the plow, is also of great value.

The corn-root aphis, which hatches in the spring from eggs laid in the fall among the

roots of the corn and collected and kept in charge there by ants throughout the winter, draws its food at first from the roots of the young weeds which spring up in the old corn fields and is transferred by ants to the corn roots after the field is planted to corn. Here it multiplies so rapidly as to bring forth in a single average season 16 generations in succession, all carefully watched and cared for by the attendant ants the whole year around. This insect can also be kept in check by a proper rotation of crops and by deep plowing and repeated stirring of old corn ground in spring as a preparation for its planting to the season's crop.

A billion dollars a year on the average is sacrificed to insects in the United States, according to careful computations and estimates made by the experts of the national Department of Agriculture. It is a prize worth fighting for, especially in these times of threatened scarcity of food. But the individual guerrilla fighting to which this interest has been left in the past will no longer suffice—has never sufficed, in fact. Carefully planned campaigns by organized communities, participated in by every one so situated as to be available, directed by experts and financed so far as necessary by the state, are the only means to success.

Turning Smoke Into Money

(Concluded from page 50)

treated for this purpose. It is also used in converting the ammonia by-products of coking ovens into ammonium sulfate. Sulfuric acid is in great demand by explosive factories, oil refiners, steel mills and varied industries engaged in the making of heavy chemicals. Sulfuric acid is likewise extensively employed by smelters and the latter are paying as high as $30 a ton today for the stuff. Sulfur dioxide is used in the preparation of wood pulp for paper making, both as a disintegrating and as a bleaching agent.

About all that need be said in description of Dr. Cottrell's method is that he demonstrated that the mere presence of an electric current would cause free particles of foreign matter to be precipitated from a gas. That, with the development of means for applying and controlling the current and for collecting the precipitated dusts, is literally all there is to it. Seldom indeed has so simple a discovery led to such wide consequences.

In dealing with noxious or objectionable gases not necessarily harmful a new aspect of precipitation arises. The electrical treater can handle only fluids or substances in the shape of particles and cannot cause the precipitation of gases, *per se*. But these gases can be made to condense upon mists of steam or of finely sprayed water, or upon extremely fine powder or dust purposely thrown into the sweep of the gases to effect this. In this way it is possible to deal with varied conditions and to abate nuisances that bade fair to cause the shutdown or removal of costly plants.

In dealing with dust alone, the first direct effort had to do with a Portland cement plant near Riverside, Cal. An electrical treater was installed there a few years ago by way of experiment, and a couple of years later was collecting something like a hundred tons of dust daily. Prior to that the dust had been scattered broadcast and settled upon the groves of adjacent orange growers, leading to extensive litigation. Analysis of the recovered dust disclosed the presence of an appreciable percentage of potash, but this attracted no marked attention at the time. Since then, particularly now that it is no longer possible for us to get potash from our prime source, Germany, this element so essential to a balanced plant food is in great demand. Last year the plant at Riverside actually started full blast to create dust as its first concern, in order to recover the potash which previously had been only a by-product in the manufacture of cement.

This is certainly a romantic development of modern industry, where an apparatus installed for the purpose of saving the life of the factory turns out to be the center of operations around which the entire plant is adjusted. In other words

the cement becomes for the nonce the by-product and the profits on the potash furnish an ample revenue, while the cement is just so much additional gain.

Anyone at all familiar with the average cement plant and the gray powdered appearance of the nearby territory can realize the boon that would be conferred by the general adoption of electrical precipitators, not only in preventing the escape of the dust but in saving the potash which is so much desired. Again, the abatement in this way of coal smoke, where communities are affected, may be made a source of revenue. The precipitated carbon or soot can be utilized, in part at least, as it forms the base of an excellent form of protective paint. In addition, electrical separation of tar from coal gas is possible, and lately it has been proved that potash can be recovered in paying quantities as a by-product from blast furnaces.

Perhaps the most interesting part of the whole story of Dr. Cottrell's success is the fact that he has presented to the Smithsonian Institution at Washington all of his valuable patents relating to the electrical precipitation of dust, smoke and fumes. The purpose of this munificence on his part was that any profits resulting from the practical application of the patents should go to the upbuilding of a fund to aid in the advancement of scientific research. In short, his hope is to help genius and to develop inventions where the needful financial aid might otherwise be lacking.

Novel French Agricultural Tractor

(*Concluded from page 54*)

design. An inverted type cone clutch, the male member being faced with an asbestos friction material is used to deliver the engine power to a three speed and reverse gearset of the automobile type. The drive to a special gearing arrangement on the rear axle is effected through a short propeller shaft. The arrangement of this gearing is such that either of the traction wheels may be driven independently of the other or both may be driven. No differential is needed with this construction and turns of very small radius may be made by locking one of the wheels with a brake provided for that purpose so that it will not turn and delivering the engine power to the outer wheel. The tractor has a wheelbase of 75 inches and measures nearly 11 feet in overall length, yet it will turn in a circle of less than eight-foot radius.

The tractor is of four-wheel design, the front wheels, which are about 24 inches in diameter being very close together and mounted on a central pivot and fork member so that they can be turned for steering. The traction wheels are about four feet in diameter and are fitted with quickly detachable lugs to be used in securing traction in soft ground. These are removed when the tractor is run over hard roads. The traction wheels are driven by worm gears, one being used for each wheel. Steering is by simple drum and chain gear to the front fork. The machine is spring suspended at both front and rear, the rear members being of the semi-elliptic leaf form, while the front end is supported by a heavy coil spring mounted in the steering head. The operator's seat overhangs the rear end of the tractor so he can control whatever machine the tractor may be hitched to as well as the tractor mechanism. The formed metal seat, so familiar on agricultural machinery is mounted at the end of a long leaf spring, and some degree of easy riding is obtained because of the flexible, yielding support.

The plowing speed is about two miles per hour. The low speed is 1.3 miles per hour and on the high speed, which is used for hauling on the road, the machine travels a little better than three miles per hour. Naturally, the control is very similar to that of an automobile of the sliding gear type with the additional lever control for the rear wheels, and the use of two brake pedals to permit independent control of the wheels. The design is highly refined and is marked by a liberal use of ball bearings on the power transmitting shafts and a thorough enclosure of the working gears in oil retaining, dust excluding housings.

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DU PONT

The Motor-Driven Commercial Vehicle

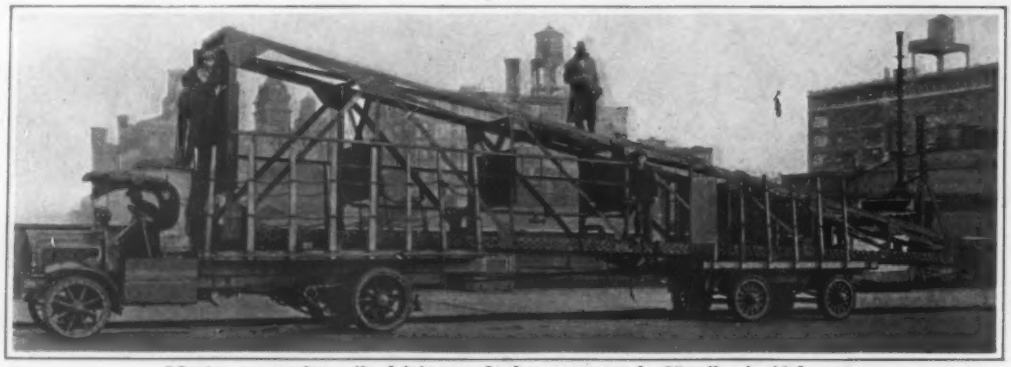
Conducted by VICTOR W. PAGÉ, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Relying on Trucks When Freight Cars Fail

FLEETS of motor trucks in service along the Atlantic seaboard have offered timely relief to many large manufacturing companies who found it impossible to secure materials or make their regular deliveries owing to the shortage of freight cars and the general terminal congestion caused by the submarine menace. In Philadelphia a good share of this business has been handled by a hauling contractor, who owns a fleet of 66 large trucks and is prepared to contract for hauls of any length.

An interesting example of how emergencies of this kind have been met is the recent hauling of several large copper chemical stills for a large chemical company of Maywood, N. J. The stills, which were 8 feet high, 7 feet in diameter and weighed nearly 5,000 pounds were built in Philadelphia. Owing to the steadily advancing price in chemicals the company ordered work on their construction rushed, but when they were ready for delivery no freight cars could be secured in which to ship them. Two of these huge tanks were loaded on one of the Philadelphia contractor's trucks and hauled to the chemical plant in less than 12 hours.



Moving a complete pile driving outfit, by motor truck, 25 miles in 18 hours

About the same time a call was received from a chemical company of Camden, N. J. This concern had a large shipment of picric acid which they wished delivered to a customer in Easton, Pa., sixty miles away. Because this acid is an ingredient in a high explosive, the railroads refused to carry it and the freight cars for shipment were not available even had they been willing to accept it for transit. The Philadelphia hauling contractor accepted the contract and a fleet of his trucks hauled the acid to Easton in 10 hours without experiencing a mishap of any kind.

At Marcus Hook, Pa., well known rug manufacturers, evaded the railroad tie-up by contracting for the use of trucks to haul long and heavy rolls of felt paper from Philadelphia to the factory, a distance of approximately 30 miles. The company was so well pleased with the work of the trucks that they have entered into a contract for hauling this paper by motor truck for a period of a year. In railroad shipments the ends of the paper rolls were frequently damaged, but the trucks deliver them in perfect condition. One truck hauls about 2,000 tons of paper a month, averaging two round trips between Philadelphia and the mill in 10 hours' time.

A short time ago a tapestry company located at North Wales, Pa., purchased a new factory in Frankfort, Pa., 60 miles away. The problem of moving the large stock of costly machinery was a serious one because North Wales offered no direct railroad communication and the plant was located several miles away from the nearest station. The cost of packing was another large item of expense and railroad officials were unable to guarantee a definite date when flat cars would be furnished for carrying the machinery. The motor truck railroad moved all of the machinery and other furnishings of the plant in a single day and it all arrived at the Frankfort factory in perfect condition, despite the fact that it was merely covered with sheets of heavy canvas. Officials of the company declared that this speed in moving saved them thousands of dollars.

Another striking example of how the railroad blockade was broken with trucks is the transportation of a stock of $80,000 worth of imported Turkish rugs from Philadelphia to New York. The rugs were loaded into an open truck and taken to a Broadway shop a distance of 96 miles in less than 10 hours.

The charge for this service was 75 cents per hundred pounds. The rugs, which were owned by prominent rug importers, had been taken to Philadelphia for exhibition purposes. When the exhibition closed the merchants desired to send them back to New York as soon as possible. The truck route was decided upon after the railroad officials had declared themselves unable to accept the rugs for shipment. The importers said that every day the rugs were in the warehouse meant hundreds of dollars to them in lost sales. The speed and dependability with which the valuable rugs were hauled from Philadelphia to New York attracted widespread attention among the business men in both cities and a few days later a representative of a foreign government offered the Philadelphian a contract to haul 15 tons of stockings from a Philadelphia stocking factory to the ocean piers in Manhattan. The steamer was scheduled to sail the next day at noon. The stockings were loaded on three trucks at 5 o'clock in the evening and unloaded on the dock in New York early the following morning.

The war abroad and the preparedness plans of the United States Government brought large contracts for munitions to a large powder company and caused the town of Penn's Grove, Pa., where the plant is located, to triple its population almost over night. The newcomers came so fast that the town butcher was unable to keep them supplied with meat. Finally a committee was appointed to search for a new butcher and to induce him to move to Penn's Grove.

Such a man was found in South Philadelphia, 45 miles from the mills, but then came the problem of moving his large stock of meats, chopping blocks, saws, refrigerator bins, chopping machines, office equipment and other furnishings. Shipments by freight were almost at a standstill. The following evening a fleet of trucks moved the butcher and all his belongings. He was open for business in Penn's Grove the following morning.

The utility of trucks in extraordinary work was strikingly demonstrated in Philadelphia a short time ago. The Emergency Fleet Corporation commandeered the plant of a large shipbuilding company "somewhere along the Atlantic Coast."

Proposed extensions to the plant for the purpose of increasing the production included new shipways which had to be supported on large concrete piles. A Concrete Pile Company was awarded the contract for driving the piles, on condition that they begin work within two days. The company's nearest pile driving equipment was in the League Island Navy Yard, 25 miles away. Railroad facilities were not available. The Philadelphia hauling contractor moved the entire outfit consisting of the pile driving tower, turn-table and bed sills, giant boilers, engines and additional equipment in 18 hours at a great saving of time and money.

Delivering large copper stills by motor truck where no cars were available

Novel French Agricultural Tractor

THE war has greatly stimulated the development, manufacture and use of agricultural tractors abroad because the lack of men and animals formerly engaged in food production has made it imperative to use machinery to raise the required quantity of food stuffs. The scarcity of labor has been met to some extent by the use of thousands of tractors, most of which are American made. One of these was recently described in these columns.

A tractor designed to meet conditions prevailing in the French vineyards as well as in general agricultural work is illustrated herewith and was described in a recent issue of *Automotive Industries*. This machine is the invention of an automobile engineer and naturally it incorporates numerous automobile engineering ideas in its make up. The American tractor makers do not make their machines narrow enough to work in French vineyards, where the grapevines are planted about a meter apart or about 39 inches. This machine is very narrow, its width being but one inch greater than three feet, this allows it to go between the vines without difficulty. The machine is of the light-weight type, to reduce fuel consumption, and the engine is of moderate power for the same reason.

The engine is of two bearing crankshaft, four-cylinder type, with the cylinders cast "en bloc." It delivers about six horse-power at the drawbar, which is sufficient tractive power to pull a two furrow plow set to cut furrows six inches deep. The machine is said to be able to plow about four acres of heavy ground or six acres of light soil in a ten-hour day. The engine has a bore of 62 mm. and a piston stroke of 145 mm., roughly 2½ by 5¾ inches. It is said to develop 10 horse-power at 1,000 turns of the crankshaft per minute. It has force-feed oiling and high tension magneto ignition and it is cooled by the natural or thermo-syphon system with the radiator placed back of the engine. The radiator is carried high enough to secure a good head of water and the water spaces and pipes are exceptionally large. A fan is carried in front of the radiator, being driven by belt connection with a large V-grooved pulley machined in the large hub of the flywheel.

The power transmission is a unique feature of this

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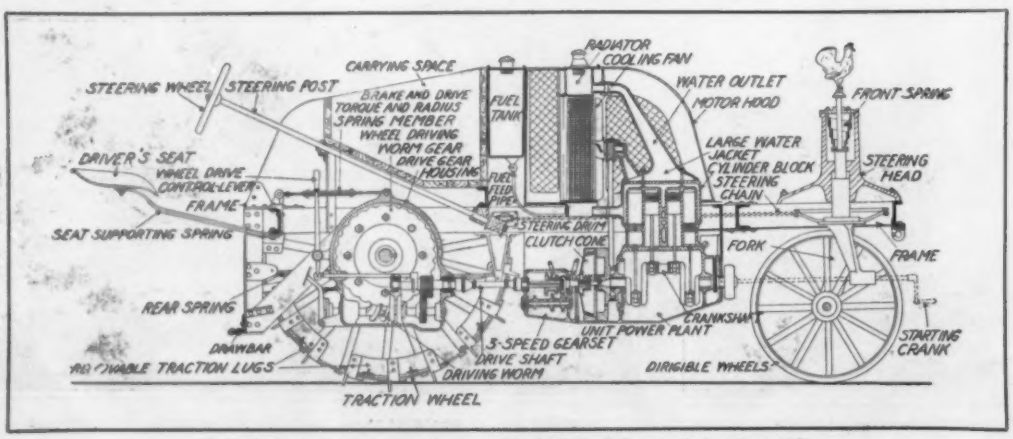


French agricultural tractor specially designed for work in vineyards

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

CONVERTIBLE GARMENT.—ELLEN M. H. WEBB, care of Hutchinson, 145 W. 98th St., New York, N. Y. The object of the invention is to provide a convertible garment combining a dress and overalls more especially designed for use by children, and arranged to permit of conveniently and quickly converting the dress into overalls or vica versa, thus allowing a child to walk to and from a playground fully and cleanly dressed, to permit the child to play while in the overalls, the dress portion being protected from being soiled.

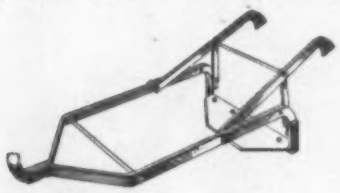
SEAM FOR RAIN COATS.—R. R. SANDFORD, New London, Ohio. The object of the invention is to provide a seam for rain coats and other similar waterproof garments, with arrangements to prevent the seam from accidentally opening and to render it waterproof. In order to accomplish the result, use is made of a strip of fabric overlying the overlapping seam sides of the garment, an adhesive substance between the contacting surfaces of the seam sides and the strip, and stitches connecting the sides of the strip with the seam sides the adhesive substance filling the stitch holes.

Pertaining to Aviation

AUTOMATIC IGNITION CUT OUT SWITCH FOR AEROPLANES.—J. S. BENNETT, care of Curtis Engineering Corp., Garden City, L. I., N. Y. The invention relates to a cut-out switch for the ignition system of an aeroplane, whereby the ignition circuit will be opened to prevent the danger of an explosion of the gasolene when the machine falls and strikes the ground or to immediately stop ignition, when necessary, the switch includes a movable element normally under spring tension and held in open-circuit position by means connected with the frame of the aeroplane and so related to the engine that when the latter is displaced the means will shift relatively and permit the switch to ground the ignition circuit.

Of Interest to Farmers

HARVESTING PLOW.—J. E. METHVIN, 224 Barbour St., Eufaula, Ala. The invention relates generally to plows, but more particularly to a plow for harvesting peanuts, the object being to provide a simple and quickly adjustable plow for this purpose, in the utilization of which, in connection



PERSPECTIVE VIEW OF THE PLOW

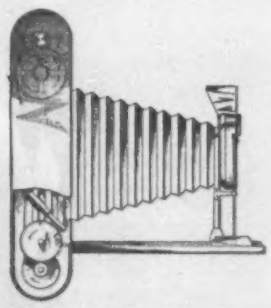
with certain characters of peanuts, the roots will be clipped or cut off, and parts thereof left in the ground in order to supply nitrogen thereto, the machine also be used for preparing the soil for crops, and effectively breaking up the ground without formation of furrows.

TRACTOR.—A. M. DAVIS, Mesa, Ariz. An object of the invention is the provision of a structure which will operate for moving in either direction, while allowing the master propelling member to move continuously in the same direction. Another object in view is to provide a tractor in which earth engaging members are provided and connected up with a primemover so as to push or pull a load.

Of General Interest

SCOOP.—D. O. TAYLOR, West Point, Miss. This scoop is of the character designed for grocers use, wherein a scoop and a handle are provided, and weighing mechanism in connection with the handle and operated by the downward movement of the scoop under the influence of the weight in the scoop, means being provided for locking the handle to the scoop in a manner to prevent the entrance of pulverulent matter during the insertion of the scoop into such matter.

CAMERA.—J. L. JOHNSON, 313-316 Liberty Bldg., Seattle, Wash. The invention has for its object the provision of a camera of the repeating type, wherein the film winding means is spring operated and normally restrained from action,

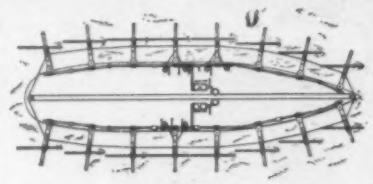


A SIDE VIEW SHOWING PARTS IN SECTION

and released by the snap of the shutter to present a new sketch of film after each exposure, and wherein means is provided for checking the action of the film winding means, when a predetermined length of film is in exposing position.

MEANS FOR SEALING STORAGE TANKS.—G. W. MERRILL, Tulsa, Okla. An object of the invention is to provide a storage tank for volatile oils having means for sealing the joints between the body portion of the tank and the roof, so as to prevent the escape of the gas, at the same time to provide means for conducting charges of electricity from the roof to the sides of the tank or vica versa, the sealing means being applicable to metal tanks of existing types.

TORPEDO-GUARD.—B. G. WILLIS, Avoca, N. C. An object of the invention is to provide a torpedo guard including a plurality of guard plates spaced from the side of the vessel to intercept a torpedo, the guard plates being adjustable either laterally or up and down toward the side



A PLAN VIEW SHOWING OPERATING MECHANISM OF THE PLATES

of the vessel to cover a breach made in the continuous line of guard by the destruction of one of the plates upon the explosion of an intercepted torpedo, the plates being pivotally mounted on vertically adjustable booms.

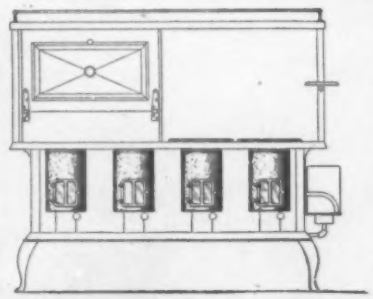
MARINE VESSEL.—E. C. BAECK, 130 N. Broadway, Irvington-on-Hudson, N. Y. The object of the invention is to provide a marine vessel more especially designed for the transportation of large amounts of supplies or freight for supplying vessels at sea or to be carried to distant ports. Other objects are to provide a base for aeroplanes, submarines or other small air or marine craft, and to permit the use of the marine vessel as a floating dry dock.

TOILET OUTFIT.—A. F. WALTZ, 503 W. 149th St., New York, N. Y. The object of the invention is to provide a toilet outfit including a pair of military brushes arranged to permit their use for brushing the hair in the usual manner and to form a convenient housing for toilet accessories or toilet article such as a toothbrush, powder box, safety razor and the like. In order to accomplish this result use is made of brush having a hollow back provided in its side wall with an opening, a drawer adapted to fit into the hollow back for holding the articles.

PENCIL ERASER ATTACHMENT.—E. G. BALCH, 103 State St., Newburyport, Mass. The purpose of the invention is to provide an attachment adapted to be applied to any ordinary pencil and comprises two main rigid parts, one movable relatively over the other and in connection with which is employed an eraser held by the relatively movable part so that a comparatively short length of the eraser is exposed for use, but which when worn down is adapted to be again exposed by movement of the movable member.

Heating and Lighting

OIL STOVE ATTACHMENT.—J. T. KELLY, West Rush, N. Y. The prime object of the invention is to provide a jacket of non-heat-conducting material to be applied to the chimney of an oil stove, whereby to prevent any material



FRONT VIEW OF AN OIL STOVE, BURNERS BEING EQUIPPED WITH THE DEVICE

radiation of the heat from the chimney into the room, and arranged to be supported on the top of the chimney in a manner to dispose the top of the jacket above the chimney. A further object is to supply a heat deflector that will permit a portion of the heat to pass directly through the grid at the center, while deflecting a portion of the heat laterally.

Machines and Mechanical Devices

TRANSMISSION MECHANISM.—R. D. GEORGE, 4341 Tracy Ave., Kansas City, Mo. The invention has for its object to provide a mechanism, wherein a driven shaft is provided consisting of sections, to each of which a disk is connected, the sections being connected by reversing mechanism so that they may rotate in the same direction, together with a connecting wheel movable radially of the disks for connecting the same to vary the relative speed of the driven shaft.

Medical Devices

ARM SUPPORT.—J. A. STOWERS and J. BAZANT, Gouverneur Hospital, New York, N. Y. The invention relates to surgical appliances, its object is to provide an arm support or sling arranged to support a broken or otherwise injured arm with the utmost comfort, and to allow of conveniently placing the arm in position on the support or removing it. To accomplish this result, use is made of a neckband attached to an open hook, adapted to receive a trough-like rest to receive and support the forearm.

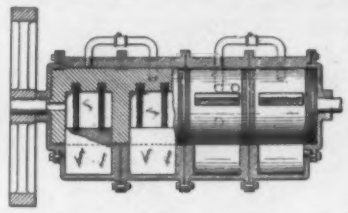
Musical Devices

JEWS' HARP.—E. O. COOK, 36 Atwells Ave., Providence, R. I. The invention relates to an instrument generally known as a jews' harp in which a vibrating tongue is secured at one end in a frame of a form to present a loop. An object is to provide a jews' harp in which the arms of the frame will be held rigid so that when the side arms are placed against the teeth of the operator they cannot be accidentally brought together to interfere with the vibrating tongue.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—H. D. GIRVAN, 2326 9th Ave., Beaver Falls, Pa. The general object of the invention is to provide an engine provided with valve mechanism having the simplicity of the puppet valve with the efficiency of the sleeve valve, and wherein the valve cannot get out of time, is not effected by carbon and needs no grinding.

ROTARY ENGINE.—W. ZABRISKIE, Pagosa Junction, Colo. The object of the invention is to provide a rotary internal combustion engine which has two cylinders, one used to compress the combustible mixture which is ignited in the other. The expanding gases act against pistons to rotate



A SECTIONAL VIEW OF THE ENGINE

a shaft, there being a by-pass in a rotable member disposed in the compressing cylinder which carries the pistons acting in the cylinder, to permit the passage of the compressed combustible mixture, this combustible mixture passing through a communicating means to the motor cylinder.

PISTON FOR INTERNAL-COMBUSTION ENGINE.—J. T. BENTHALL, Suffolk, Va. An object of the invention is to provide a piston whereby an increase of power is obtained. The construction provides a piston having a head, the greater portion of which is a plain flat surface, with outwardly curved edges, the curved portions being relatively near to the sides of the piston, by this form of construction, the force of the explosion along the side walls is deflected away from the point of escape around the piston head and focused directly upon the piston head.

Railways and Their Accessories

VESTIBULE CURTAIN COUPLING.—M. J. ROCHE, 13 Manheim St., Elmhurst, L. I., N. Y. The invention relates particularly to a construction for coupling the curtains used on vestibules of railway coaches, the main object is to provide a structure which holds the curtain in proper position but will automatically become disengaged. A further object is to provide a coupler having a head or knob with pivotally mounted jaws engaging the same, and a sleeve holding the jaws in position until the cars have separated and pulled the head to a position outside the sleeve.

LOCOMOTIVE TENDER COAL PIT.—E. G. BARTLETT, address P. Dandelin, 81 Pennsylvania Ave., East Somerville, Mass. The invention deals particularly with the construction of a coal pit, whereby the automatic feed of the coal by gravity is positively insured. The special aims of the invention are to supply the coal to the fireman constantly and keep the whole mass of coal in motion so that it will not pack down solid without the use of any mechanism, being an integral part of the tender, the upkeep after installment costing no more than the common coal pit.

AUTOMATIC TRAIN-STOP.—M. B. BULLA, 216 Martin Bldg., El Paso, Texas. An object of the invention is to provide automatic train control mechanism including a normally closed circuit, the breaking or disarrangement of any part of which will insure the stopping of the train. A further object is to provide means whereby, even though the automatic stopping mechanism is controlled by the normally closed circuit, yet the engine driver is enabled to pass a danger point if required to do so under orders without initiating the action of the automatic stopping mechanism.

PISTON PACKING RING.—E. R. BALES, 206 North Hickory St., Centralia Ill. The invention relates to packing rings adapted to be employed more particularly on the pistons of locomotive power reversing gears, air brake triple-valve pistons, and other devices in which the movement of the piston must be controlled by very small difference of pressure on the respective sides thereof. This object is attained by employing a pair of packing rings representing opposite leveled surfaces at their inner corners and an expanging ring exerting a wedging action on the packing rings at the surfaces to force the packing rings obliquely outward.

Pertaining to Recreation

GAME APPARATUS.—E. HECKMANN, Box 91, Hermann, Mo. The object of the invention is to provide a game having a board with a gate at one end, there being two sets of openings in the board beyond the gate, one set at each side of the board, the openings at one side of the board indicating offensive plays with a penalty if the player does not succeed in making the play attempted, and at the other side defensive plays with a penalty if the player does not make the attempted play.

Pertaining to Vehicles

VEHICLE WHEEL.—J. F. KEMP, Manila, Philippine Islands. The invention relates generally to vehicle wheels, but more particularly to a construction thereof embodying relatively movable parts whereby to bring about resilient support of a vehicle, and between which parts an inflatable tube is interposed, of greatly reduced cross section and circumference with respect to the usual inflatable tube at the tread of a wheel, thus saving materials, eliminating all punctures, and reducing the cost of upkeep.

THERMOSTATIC FAN.—R. N. COATS, 305 First Ave., So. Seattle, Wash. The object of the invention is to provide thermostatic fan more especially designed for use on automobiles and similar vehicles for controlling the air circulated through the radiator to maintain the water in the radiator at a desired temperature. In order to accomplish the result use is made of a fan wheel and thermostatically controlled means mounted on the fan for turning the latter according to the temperature of the surrounding atmosphere.

MOTOR CYCLE ATTACHMENT.—G. E. FRETZ, 423 S. High St., Pratt, Kans. The invention relates to a motor cycle controlling clutch. The object is to provide controlling means associated with the clutch lever and its actuating lever and arranged to counterbalance the increasing spring pressure exerted by the clutch spring when the clutch is moved away from the engaged position, so that the clutch will be maintained in any given position including that of partial engagement.

REAR END SIGNAL FOR VEHICLES.—G. RUSIAS, care of M. E. Canle & Co., 79 Wall St., New York, N. Y. Among the principal objects which this invention has in view are to provide a simple means for indicating a warning in trafic, to imploy a single device for indicating various intentions, to provide a structure difficult to damage, and provide means for operating the signal in correspondence with the operation of the automobile with which the signal is associated.

DIRIGIBLE HEADLIGHT CONNECTION.—H. D. HARVEY, Hillsdale, N. Y. The invention has particular reference to means for swinging headlights laterally coincidentally with the turning of the vehicle. Among the objects is to provide means whereby the headlights of an automobile are adapted to be so connected to the steering devices of the front wheels as to be turned automatically in connection with the steering of the vehicle, but with provision made so that the lamps may be left stationary with respect to the body if desired.

RESILIENT VEHICLE TIRE.—DR. I. N. KEIM, Mount Holley, N. J. The object of the invention is to provide a resilient tire having a body made of rubber or similar resilient material subjected to flexion and extension and eliminating

A CROSS SECTION OF THE TIRE

direct compression. In order to accomplish the result, use is made of a hollow rubber annulus adapted to be fastened to the felly of the wheel, a floating metal rim attached to the peripheral face of the resilient body, and a rubber treat attached to the floating metal rim.

CLUTCH.—M. C. DART, care of Kremser, 326 E. 155th St., New York, N. Y. Among the principal objects of this invention are, to avoid shocks when coupling power mechanism with transmission mechanism, to automatically release the transmission mechanism from adjacent parts of the driving mechanism under certain prearranged conditions, to provide a simple slipping clutch, and to provide means for compensating for the disalinement of transmission and driving elements when operatively connected by the clutch.

VEHICLE SPRING SUSPENSION.—J. TREANOR, 310 W. 121st St., New York, N. Y. The invention relates to automobiles and other vehicles. Its object is to provide a spring suspension arranged to minimize jolts and jars incident to the vehicle traveling over rough roadways

A SECTIONAL SIDE ELEVATION OF THE SPRING AS APPLIED

thus insuring easy riding. Another object is to permit the use of comparatively light springs. In order to accomplish the result use is made of connected levers fulcrumed on the vehicle body, one of the levers being connected with the axle, and a spring supported on the vehicle body and engaged by another of the said levers.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Salvage of Deeply Sunken Ships

(*Concluded from page 43*)

action by spacing them along on each side of a wreck.

The pontoons can be adjusted vertically for a movement of thirty feet. That is to say, when a vessel is carried by them into water having a maximum depth of thirty feet their field of service ceases and other salvage practices must be employed. Their primary purpose is to deal with deeply submerged ships; to raise them successively in thirty foot stages while moving into shallower depths; and, finally, to ground the craft in protected waters where the wreckers can complete their job without the hazards and difficulties incident to work in the open sea. The vertical movement of the pontoons when shortening up the slings for another lift is effected by weighting the cylinders with water ballast or by taking advantage of the falling tide—the ship in the meantime resting upon the seabed. Pontoons of this nature have another advantage over those that are entirely submerged, because they are always visible and can therefore, be controlled from the surface with a fuller instant grasp of the problem as a whole.

Divers need be employed but sparingly. All that would be required of them is to help locate the exact place and posture of the wreck and to direct the adjustment of the slings as they are brought under the bow or the stern of the vessel and worked, by the aid of the excavating air blast, into the required positions. The cylinders are substantially self-contained salvage units, and only towing vessels and a moderate floating plant would be needed to raise a ship.

The Teleferica

(*Concluded from page 46*)

and length of the lift—is always installed at the upper station. The usual provision is for two baskets, one coming up while the other goes down. As with the ore-tramways, however, an installation can be made—if sufficient power is available—to carry two baskets or three, or even a greater number of baskets.

The two greatest enemies of the teleferica are the avalanche and the wind—the latter because it may blow the baskets off the cable and the former because it may carry the whole thing away. As the tracks of snow-slides—the points at which they are most likely to occur—are fairly well-defined, it is usually possible to make a wide span across the danger-zone with the cable and thus minimize the chance of disaster on this score. It is only when the dread "Valanca"—as occasionally happens—is launched at some unexpected point that damage may be done to an aerial tramway.

Though the number of disasters of this kind from avalanches may be counted upon one's fingers, trouble from high wind is always an imminent possibility. In the early days of the teleferica accidents traceable to the blowing off of the baskets were fairly common; in fact, it was feared for a time that the difficulty from this source might be so great as materially to limit the usefulness of the cableway system. The use of more deeply-grooved wheels, however, did away with this trouble almost entirely, so that now the only menace from the wind is when it comes from "abeam" and blows hard enough to swing the baskets into collision when passing each other in mid-air.

All sorts of freight, from ducks and donkeys to shells and cannon, have been carried by the teleferica, and one of the best stories told on the Italian Front had to do with a pig—the mascot of a Dolomite glacier—which found its way up there by means of the cable. He was a sucking-pig, and was sent up alive to be reared for the major's Christmas dinner, when the teleferica basket in which he was traveling got stuck in a drift which had encroached upon one of the steel towers. Twelve hours elapsed before it was shoveled free, and the sucking pig, when it finally reached the top, was frozen hard and stiff as one of his cold-storage brothers. It was only after he had lain in the hot kitchen for several hours that an indignant grunt revealed the astonishing fact that his armor of fat had kept smouldering a spark of life. They reared him on a bottle, and today he is a porker of 200 pounds or more, drawing a regular ration of his own.

The other winter a teleferica was destroyed by an avalanche, leaving a band of Alpini marooned on the side of a glacier with only a few days' supply of food and ammunition. The story has been told in these columns in connection with a cover drawing which depicted the incident, but perhaps it will bear repeating. The difficulty was to reach these men. To have repaired the teleferica would have been the work of several weeks, and the only path leading to their eerie was scoured away by the slide. No doubt the mountaineering genius of the Alpini would have been equal to the problem of finding their way back to safety by letting each other down by ropes, but this would have involved the abandonment of a position which it was vitally important to hold.

The somewhat daring expedient of shooting a cable up from a gun was accordingly resorted to as a quick means of succoring the marooned men. A shell attached to a light cable went wide, and all attempts with high-velocity guns were failures. It was not until one of the new long-range trench-mortars was brought up that the experiment took an encouraging turn, though success was not won until the cable's line was displaced by a light manila rope. This was fired to its goal—an eminence half a mile distant and 1,000 feet high—at the first shot, and afterwards served to drag up a light cable which in turn dragged up the heavy one. In this way communication was quickly restored.

Perhaps the most spectacular exploit ever carried out from a teleferica was that by which a troublesome nest of Austrian machine-gunners was cleared off one of the pinnacles of the great M——— *massif* in the fall of 1916. At that time the lofty ridge was divided between the Italians and Austrians. The latter had access to one splintered pinnacle which, although there was no room to establish a permanent position there, offered a splendid vantage from which to observe all Italian movements in the valley beneath. The situation was irritating enough for the Italians even when the activities of the enemy were confined only to observation, but when he took to bringing a machine-gun up and peppering—almost from its rear—the headquarters of an Alpini battalion which held an important pass 3,000 feet below, it became well nigh intolerable.

Then one of the engineers discovered that there was a point between the third and fourth towers of a nearby teleferica from which the Austrian machine-gun position could be enfiladed with deadly effect. Accordingly the platform of a machine-gun was hung on to the cable at an angle which would make it easy to elevate and range on the Austrian position above. The exposed side of the platform was protected by a sheet of bulletproof steel. When all was ready a gunner and an engineer took up their positions on the platform and over all a black tarpaulin was thrown in order to deceive the Austrians as to the nature of the load. When the desired elevation was gained, the tarpaulin was thrown back and a rain of lead was poured upon the troublesome gun. It was so unexpected, coming from the air, that before the Austrians could turn their gun upon the aerial attackers, they were all killed, and the Italians experienced no further trouble from this quarter. Our cover drawing this week is based upon this incident.

Fifty Billion German Allies Already in the American Field

(*Concluded from page 47*)

worms are found to be abundant on corn land, but proper rotation of crops is the best preventative measure. Pasturing hogs upon land supposed to harbor cutworms is a beneficial practice, as these animals root up and devour insects of many kinds, including cutworms, in large numbers. Farm poultry, allowed to follow the plow, is also of great value.

The corn-root aphis, which hatches in the spring from eggs laid in the fall among the

roots of the corn and collected and kept in charge there by ants throughout the winter, draws its food at first from the roots of the young weeds which spring up in the old corn fields and is transferred by ants to the corn roots after the field is planted to corn. Here it multiplies so rapidly as to bring forth in a single average season 16 generations in succession, all carefully watched and cared for by the attendant ants the whole year around. This insect can also be kept in check by a proper rotation of crops and by deep plowing and repeated stirring of old corn ground in spring as a preparation for its planting to the season's crop.

A billion dollars a year on the average is sacrificed to insects in the United States, according to careful computations and estimates made by the experts of the national Department of Agriculture. It is a prize worth fighting for, especially in these times of threatened scarcity of food. But the individual guerrilla fighting to which this interest has been left in the past will no longer suffice—has never sufficed, in fact. Carefully planned campaigns by organized communities, participated in by every one so situated as to be available, directed by experts and financed so far as necessary by the state, are the only means to success.

Turning Smoke Into Money

(*Concluded from page 50*)

treated for this purpose. It is also used in converting the ammonia by-products of coking ovens into ammonium sulfate. Sulfuric acid is in great demand by explosive factories, oil refiners, steel mills and varied industries engaged in the making of heavy chemicals. Sulfuric acid is likewise extensively employed by smelters and the latter are paying as high as $30 a ton today for the stuff. Sulfur dioxide is used in the preparation of wood pulp for paper making, both as a disintegrating and as a bleaching agent.

About all that need be said in description of Dr. Cottrell's method is that he demonstrated that the mere presence of an electric current would cause free particles of foreign matter to be precipitated from a gas. That, with the development of means for applying and controlling the current and for collecting the precipitated dusts, is literally all there is to it. Seldom indeed has so simple a discovery led to such wide consequences.

In dealing with noxious or objectionable gases not necessarily harmful a new aspect of precipitation arises. The electrical treater can handle only fluids or substances in the shape of particles and cannot cause the precipitation of gases, *per se*. But these gases can be made to condense upon mists of steam or of finely sprayed water, or upon extremely fine powder or dust purposely thrown into the sweep of the gases to effect this. In this way it is possible to deal with varied conditions and to abate nuisances that bade fair to cause the shutdown or removal of costly plants.

In dealing with dust alone, the first direct effort had to do with a Portland cement plant near Riverside, Cal. An electrical treater was installed there a few years ago by way of experiment, and a couple of years later was collecting something like a hundred tons of dust daily. Prior to that the dust had been scattered broadcast and settled upon the groves of adjacent orange growers, leading to extensive litigation. Analysis of the recovered dust disclosed the presence of an appreciable percentage of potash, but this attracted no marked attention at the time. Since then, particularly now that it is no longer possible for us to get potash from our prime source, Germany, this element so essential to a balanced plant food is in great demand. Last year the plant at Riverside actually started full blast to create dust as its first concern, in order to recover the potash which previously had been only a by-product in the manufacture of cement.

This is certainly a romantic development of modern industry, where an apparatus installed for the purpose of saving the life of the factory turns out to be the center of operations around which the entire plant is adjusted. In other words

the cement becomes for the nonce the by-product and the profits on the potash furnish an ample revenue, while the cement is just so much additional gain.

Anyone at all familiar with the average cement plant and the gray powdered appearance of the nearby territory can realize the boon that would be conferred by the general adoption of electrical precipitators, not only in preventing the escape of the dust but in saving the potash which is so much desired. Again, the abatement in this way of coal smoke, where communities are affected, may be made a source of revenue. The precipitated carbon or soot can be utilized, in part at least, as it forms the base of an excellent form of protective paint. In addition, electrical separation of tar from coal gas is possible, and lately it has been proved that potash can be recovered in paying quantities as a by-product from blast furnaces.

Perhaps the most interesting part of the whole story of Dr. Cottrell's success is the fact that he has presented to the Smithsonian Institution at Washington all of his valuable patents relating to the electrical precipitation of dust, smoke and fumes. The purpose of this munificence on his part was that any profits resulting from the practical application of the patents should go to the upbuilding of a fund to aid in the advancement of scientific research. In short, his hope is to help genius and to develop inventions where the needful financial aid might otherwise be lacking.

Novel French Agricultural Tractor

(*Concluded from page 54*)

design. An inverted type cone clutch, the male member being faced with an asbestos friction material is used to deliver the engine power to a three speed and reverse gearset of the automobile type. The drive to a special gearing arrangement on the rear axle is effected through a short propeller shaft. The arrangement of this gearing is such that either of the traction wheels may be driven independently of the other or both may be driven. No differential is needed with this construction and turns of very small radius may be made by locking one of the wheels with a brake provided for that purpose so that it will not turn and delivering the engine power to the outer wheel. The tractor has a wheelbase of 75 inches and measures nearly 11 feet in overall length, yet it will turn in a circle of less than eight-foot radius.

The tractor is of four-wheel design, the front wheels, which are about 24 inches in diameter being very close together and mounted on a central pivot and fork member so that they can be turned for steering. The traction wheels are about four feet in diameter and are fitted with quickly detachable lugs to be used in securing traction in soft ground. These are removed when the tractor is run over hard roads. The traction wheels are driven by worm gears, one being used for each wheel. Steering is by simple drum and chain gear to the front fork. The machine is spring suspended at both front and rear, the rear members being of the semi-elliptic leaf form, while the front end is supported by a heavy coil spring mounted in the steering head. The operator's seat overhangs the rear end of the tractor so he can control whatever machine the tractor may be hitched to as well as the tractor mechanism. The formed metal seat, so familiar on agricultural machinery is mounted at the end of a long leaf spring, and some degree of easy riding is obtained because of the flexible, yielding support.

The plowing speed is about two miles per hour. The low speed is 1.3 miles per hour and on the high speed, which is used for hauling on the road, the machine travels a little better than three miles per hour. Naturally, the control is very similar to that of an automobile of the sliding gear type with the additional lever control for the rear wheels, and the use of two brake pedals to permit independent control of the wheels. The design is highly refined and is marked by a liberal use of ball bearings on the power transmitting shafts and a thorough enclosure of the working gears in oil retaining, dust excluding housings.

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